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INDICES OF PHYSIOLOGICAL MATURITY: DERIVATION AND INTERRELATIONSHIPS[1]

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One of the goals of the Guidance Study has been to determine the relative contributions of the various bio-social factors associated with normal or deviating personality development. One such factor is physiological maturity, but before its relationship to personality could be studied, a method of assessing progress along the hypothetical maturational continuum had to be evolved. This paper concerns the derivation and interrelationships of indices which could be used to this end.

In this study both external and indirect signs of an individual's progress toward maturity were considered. The search for indicators of growth rests on the belief that maturity is largely determined by endocrine factors evidenced in various discernible phenomena. With this in mind, many workers in the field have used "growth indices" to classify subjects as "early," "average," or "late" maturers. Usually one such measure, e.g., age at menarche, is utilized, perhaps with others then related to it. The scores of individuals on many variables must be studied, however, before it is possible to estimate the relative validity of any one variable. One of the objectives of the present study, therefore, was to determine the degree of generality in adolescent physical growth by means of a factorial analysis of the intercorrelations among various measures of maturation. A second objective was to use the general factor, if one should be found in such an analysis, as a criterion from which the relative efficiencies of the single measures of maturation could be evaluated. Our final goal was to assign each young person a Maturity Score which would (*a*) be based on the best single measure or combination of measures of the hypothetical factor, and (*b*) fall along a continuous rather than dichotomous dimension.

The development of the separate measures or indices of maturation is described in Section I. The factorial analysis and the derivation of maturity

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[1] This study was carried out under the direction of Dr. Jean Walker Macfarlane of the Guidance Study at the Institute of Child Welfare. Special acknowledgment is due to Gene Rolfe La Forge, Marjorie P. Honzik, and Nancy Bayley for their suggestions and criticisms. The charts were drawn by Katherine Eardley.

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* Deceased.

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scores are to be found in Section II; Section III presents a discussion of the findings.

GROUP STUDIED

The children included in the Guidance Study constituted a representative sample of those born in Berkeley, California, in 1928 and 1929. The parents of this sample, however, have a higher educational level than is true for the United States at large (8).

The boys and girls were first brought to the Institute for a complete physical examination at the age of 21 months.[2] Age of Walking and earlier measurements of height were available from the data collected in the Berkeley Survey (11). At this time there were 252 children in the group. Following the first visit, the boys and girls were seen at yearly intervals until they were 8 years of age and at half-year intervals thereafter. By the time these individuals were 18 years old, 50 families had moved; 39 children had stopped coming to the Institute because they or their parents had lost interest in the study; and one child had died. We have measurements on from 61 to 92 boys and from 70 to 97 girls at the different age levels.

I. DEVELOPMENT OF INDICES

Measures of maturity which had been used by other workers and were capable of reliable determination were selected for study. Indices used for girls were (*a*) age at menarche, (*b*) development of breasts, and (*c*) development of pubic hair; for boys, amount and patterning of pubic hair and size of penis and testes; and for both sexes, (*a*) age at reaching maximum growth, (*b*) skeletal development, (*c*) per cent of mature height, and (*d*) age of walking.

The method of assigning scores on the variables was the next problem. It was possible to score in terms of the variable itself (for example, the skeletal age an individual had attained at a given chronological age) or in terms of the chronological age at which a stated degree of maturation (i.e., a particular skeletal age) had been reached. Except in determinations of chronological ages for menarche, maximum growth, and walking, the former has been the usual practice. The latter method, i.e., scoring in terms of the chronological age at which given maturational stages were reached, was used because it had the following advantages:

1. The computation of scores in terms of "age at reaching" provided a common basis for scoring and evaluating both the continuous and the discrete vari-

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[2] The anthropometric measurement program was planned by Dr. Herbert R. Stolz. The measurements covering the 18 year period were made by him and the staff physicians: Drs. George Bates, Leona Bayer, Ellen Brown, Eleanor Erickson, Ann Martin, Louis Needels, Harold Roe, Anton Schaefer, Dorothy Sproul, Charles Stevenson, Philip Van Horn, and Lotta Wolff; and by research associates and assistants: Ed Radsliff, Margaret Snyder, and R. D. Tuddenham.

ables. Thus, the skeletal and sex stages, for example, had as a "base line" a common dimension with equal intervals.

2. The means and sigmas of each variable could be calculated in chronological age units, thus permitting each subject's development on all variables to be represented on a single graph.

Following this over-all plan, an individual's chronological age score was computed for every index, and norms were calculated for each variable. Relationships between measures and ratings were determined by use of product-moment correlation coefficients.[3] In the following pages each index will be considered separately.

Age at Maximum Growth

This index is the chronological age at which the largest increment in standing height occurs during the adolescent period. The procedure is taken from Shuttleworth (14). The only departures of consequence are the use of half-yearly rather than yearly increments, and the designation of Age at Maximum Growth as the midpoint rather than the end of the age interval during which the largest increment occurred, thereby allowing errors to vary unsystematically. Taking the end of the interval as Age at Maximum Growth will increase the value of the mean age, since all errors are positive, i.e., overestimate the true value. If the midpoint is used, some errors will be positive and some negative in value and will tend to cancel out each other.

In order that a determination of reliablity could be made, two methods of designating Age at Maximum Growth were used: (*a*) *graphic* and (*b*) *arithmetic*. The *graphic method* determined rate of growth per half year by the following procedure:

1. For each individual, a graph was made with age on the horizontal axis and height increments on the vertical axis. The height increments were plotted at the age levels of the original height measurements.

2. In the typical case, the interval in question was exactly one-half year, and no correction of rate was necessary, only the midpoint correction being made, i.e., the amount of the increment being plotted at the midpoint of the age interval.

3. If, however, a height measurement had not been made exactly at the half-year interval, the increment was plotted at the end of the irregular interval and a diagonal drawn from this point to the abscissa at the beginning of the interval. From the abscissa at a point a half year to the right of the beginning of the interval, a perpendicular was erected. The ordinate value of the point of intersection of this perpendicular and the diagonal indicated the rate of growth per half year. Thus, an original increment of four centimeters occurring over a period of eight months would be plotted as a rate of growth of three centimeters

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[3] Much of the arduous clerical and statistical work was done by Ben Ard, Lee Cohen, Irene Dempsey, Philip Deuel, Natalie Dukes, John Enright, Britomar Hanlon, and Toshiko Onouye.

per half year. The midpoint of the irregular interval then was designated as the locus of the increment.

4. To neutralize the remaining irregularities due to errors in measurement or to actual irregularities in growth, a relatively smooth, free-hand curve was drawn through the midpoints. The maximum of the curve was determined and the corresponding age recorded as Age at Maximum Growth.

The *arithmetic method* was suggested by Shuttleworth (14, p. 3): "If the Harvard Growth Study had obtained its measurements at quarterly or even at semiannual intervals, determinations of age at the close of the year of maximum growth in standing height would be comparatively simple. It would only be necessary to compute the successive annual increments and select the point at which the largest increment in standing height occurred." When half-yearly increments were considered singly, however, the errors of measurement were almost as large as the trends we wished to measure, but adding to each half-yearly increment the increment for the preceding half year gave yearly increments relatively larger than the errors of measurement. From these progressively shifting annual increments, the midpoint of the largest was obtained and designated Age at Maximum Growth.

Since the graphic method gave a pictorial representation of this growth pattern for each individual and equalized increments over the whole age span in question, it was used to determine Age at Maximum Growth. Its reliability was checked by comparison with the results from the arithmetic method.

Results. Among Age at Maximum Growth determinations for 86 boys, there were six instances where the difference between the two methods was greater than a half year; for the 87 girls, there also were six differing by more than a half year. Two judges inspected the graphic and arithmetic determinations to find the cause of the discrepancy in these 12 cases and to choose one of the two Age at Maximum Growth scores, the choice being based on such considerations as missing measurements, unequal intervals, and changes due to smoothed curves. This inspection revealed, in addition, that the 12 disparate cases had relatively flat increment curves.

TABLE 1

INTER-RATER AGREEMENT OF MAXIMUM GROWTH DETERMINATIONS

	Boys		Girls	
Cases	*N*	*r*	*N*	*r*
All determinations	86	+.80	87	+.94
Cases with greater than half-year differences omitted	80	+.96	81	+.96

Determinations of inter-rater agreement using the graphic method were made for each sex with and without the disparate cases. The results are presented in Table I. The correlation coefficients are .80 for boys and .94 for girls when based on all determinations, and .96 for both sexes when the cases with greater than half-year differences are omitted. On the basis of these data, the graphic method was used routinely to estimate Age at Maximum Growth for all cases where the difference between the two methods was less than one-half year, and the judges' choice governed the remaining 12 cases.

TABLE 2

CHRONOLOGICAL AGE AT WHICH MAXIMUM GROWTH IS ATTAINED

	Boys			Girls		
Cases	*N*	*Mean* (years)	*Sigma* (years)	*N*	*Mean* (years)	*Sigma* (years)
All cases	86	13.77	1.17	87	11.51	1.13
Minus cases with greater than .50 difference in the two determinations ..	80	13.75	1.07	81	11.51	1.12

Means and standard deviations of Age at Maximum Growth scores are presented in Table 2. The average Age of Maximum Growth is 11.5 years for girls and 13.8 for boys. It is interesting to note that there is virtually no difference in these results whether one considers only the smaller, more reliable groups or adds the judges' ratings for the originally discrepant cases. The distributions of Age at Maximum Growth for both sexes are shown in Figure 1, the earlier maturation of the girls being strikingly apparent.

Stages in Sexual Development

The assesment of growth in sexual development was based on the temporal sequence in which discernible changes occur in external sexual characteristics of males and females. For boys, penis size and amount and patterning of pubic hair were chosen; for girls, breast development and amount and patterning of pubic hair.

Male scale. Greulich has pointed out that: "*The increase in the size of the testes and . . . penis are among the earliest* detectable signs of beginning puberty. It often precedes by a year or more the first appearance of definite pubic hair. The changes in the dimensions of the male external genitalia can be recorded adequately by means of serial photographs . . ." (5, p. 67).

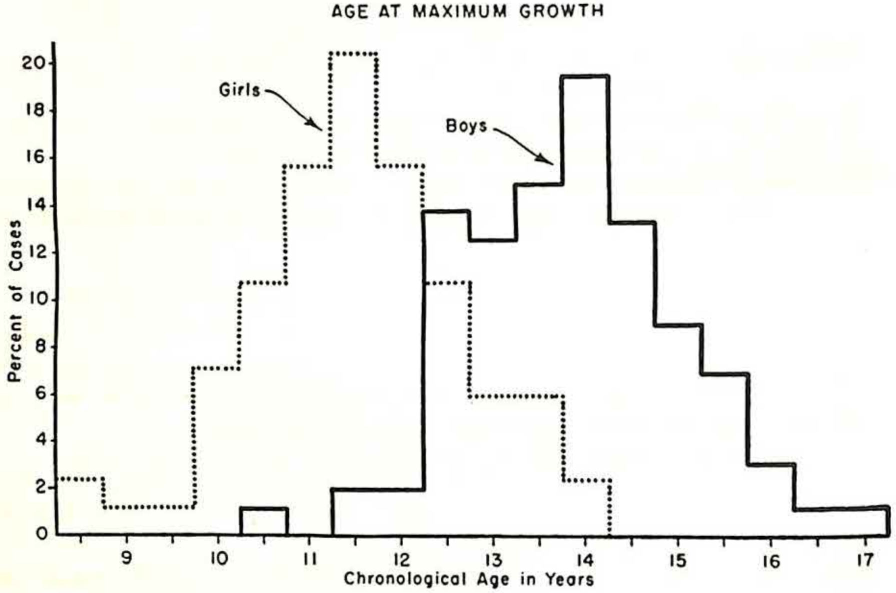

FIGURE 1

From these considerations and the study of distributions of facial and axillary hair, Greulich *et al.* developed a five-category scale to be used in rating stages of sexual maturity in boys (6, p. 15). Since his approach fitted our purposes, the five classifications plus the photographic standards were used.[4] In summary, these stages were:

Sex Stage I —Penis, testes, and scrotum are essentially the same as in early childhood.

Sex Stage II —Testes and penis have noticeably enlarged; lightly pigmented downy hair has appeared.

Sex Stage III—The penis has appreciably lengthened; downy hair is interspersed with straight coarse pigmented hair.

Sex Stage IV—Larger testes and penis of increased diameter are apparent. Pubic hair looks adult but its area is smaller.

Sex Stage V —Genitalia are adult in size and shape; pubic hair is adult.

Female scales. In girls the differential development of breasts and pubic hair necessitates the use of separate scales for each variable. After considering the breast development scales of Stratz (5, p. 66) and Reynolds and Wines (12, p. 5), the following scale was devised:

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[4] Facial and axillary hair could not be rated from our photographs.

Breast Stage I —Prepuberal breast, elevated papilla only (similar to Stage I of Stratz and of Reynolds and Wines).

Breast Stage II —Elevated areola (similar to Stage II of Stratz and of Reynolds and Wines).

Breast Stage III—First swelling of the breast to a small mound formation (similar to Stage III of Reynolds and Wines).

Breast Stage IV—Terminal stage, beyond which no further *developmental* changes appear in breast contour (similar to Reynolds and Wines' Stage V).

Size and shape of breast as such were not considered. Our purpose was to chart differences meaningfully related to general physiological development, not to study the details of breast development *per se*; hence our scale, which covers only gross, readily discernible changes, was felt to be more adequate for our needs than other more discriminatory scales.

For pubic hair ratings, the five-point scale of Reynolds and Wines (12, p. 16) was used:

Hair Stage I —Infantile, no pigmented pubic hair.

Hair Stage II —Hair pigmented, straight or only slightly curled; sparse, primarily along the labia.

Hair Stage III—Hair curled; slight spread on mons.

Hair Stage IV—Hair curled; moderate amount and spread.

Hair Stage V —Hair tightly curled; profuse definite inverse triangular pattern extending to the inguinal region and corresponding to the horizontal type described by Dupertius and associates.

Nude (4½" x 7") photographs taken under standard conditions were available at half-yearly intervals from 8 through 18 years. For both sexes, judges independently rated all pictures seriatim in relation to each individual's final development, rather than on absolute standards. Inter-rater differences were determined (see Tables 3 and 4) and conference ratings were made where discrepancies occurred.

The chronological age at which an individual progressed from one stage to the next was designated by the midpoint of the age interval involved. Thus if a boy was in Sex Stage I at 12.00 years and in Sex Stage II at 12.50 years, his age at reaching Sex Stage II would be 12.25 years. Since photographs were taken routinely every half year, the intervals dealt with were most frequently .50 years.[5]

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[5] When a picture was missing, however, an interpolation was made only if the age interval was no larger than 1.20 years; otherwise no attempt was made to obtain the age for the particular stage. The 1.20-year interval was in general no larger than the standard deviation of each rater's distribution (omitting the interpolated change points), and the means and standard deviations of the entire group were very close to those calculated without the interpolated data; consequently, it was believed that the gain in the number of cases justified the use of the interpolations. These also were utilized when all photos were present, but the change was so rapid that an intermediate stage had not been photographed.

TABLE 3

INTER-RATER AGREEMENT FOR RATINGS OF BOYS' SEXUAL CHARACTERISTICS BASED ON PHOTOGRAPHS

Chronological Age of Reaching	*N*	*r*
Stage II	91	+.86
Stage III	89	+.89
Stage IV	89	+.96
Stage V	79	+.86

Results. The correlations between the judges' ratings of sexual development are shown in Tables 3 and 4.[6] The inter-rater agreement on boys' scores, ranging from .86 for Stages II and V to .96 for Stage IV, seemed high enough to warrant using all these stages as indices of development. This was also true of the girls' ratings, with correlations ranging from .98 to .70, *except in the case of Hair Stage V. The low reliability of this latter stage led to its being dropped.* In order to increase the reliability of the ratings, the judges made conference ratings in all cases where discrepancies existed. These ratings, together with the original, nondiscrepant ratings, were used as final scores on the sexual indices.

TABLE 4

INTER-RATER AGREEMENT FOR RATINGS OF GIRLS' SEXUAL CHARACTERISTICS BASED ON PHOTOGRAPHS

Chronological Age of Reaching	*N**	Raters 1, 2 *r*	Raters 2, 3 *r*	Raters 1, 3 *r*
Breast Stage II	73	+.85	+.92	+.82
Breast Stage III	91	+.92	+.93	+.86
Breast Stage IV	82	+.75	+.70	+.75
Hair Stage II	88	+.94	+.98	+.93
Hair Stage III	87	+.93	+.89	+.92
Hair Stage IV	82	+.81	+.88	+.80
Hair Stage V	69	+.55	+.74	+.55

* Average of three *N*'s for the three different reliability coefficients.

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[6] The ratings of the sexual characteristics were made by Ben Ard, Edith Katten, Karyl Miner, and the authors.

TABLE 5

CORRELATIONS BETWEEN THE AVERAGE OF INDEPENDENT RATINGS OF JUDGES AND THEIR FINAL RATINGS

Chronological Age of Reaching	*N*	*r*
Boys:		
Stage II	91	+.96
Stage III	89	+.96
Stage IV	89	+.98
Stage V	79	+.91
Girls:		
Breast Stage II	78	+.97
Hair Stage II	90	+.98
Breast Stage III	94	+.97
Hair Stage III	88	+.97
Breast Stage IV	87	+.95
Hair Stage IV	84	+.91

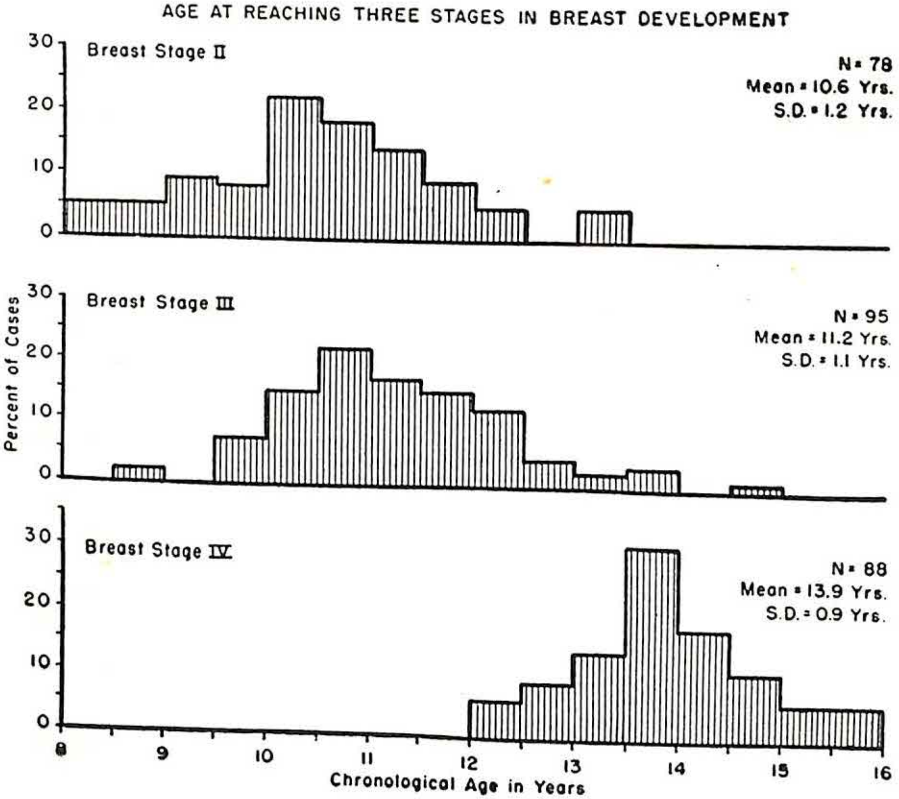

FIGURE 2

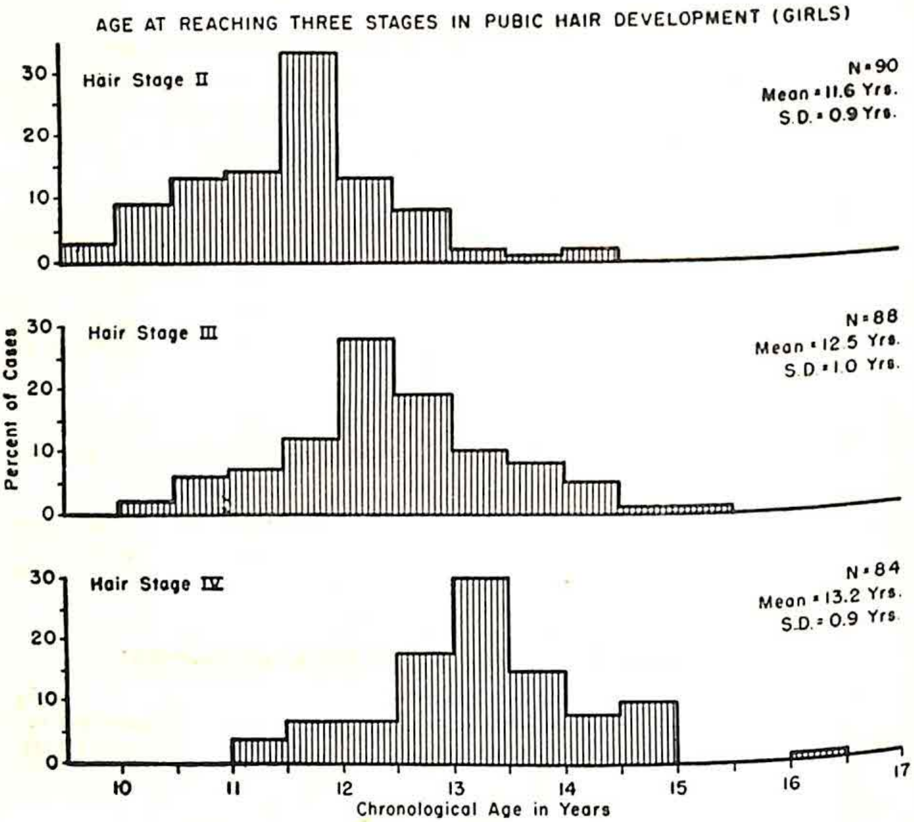

FIGURE 3

It was impossible to determine the reliability of the final ratings, since a part-whole problem exists, but their correlations with the averaged independent ratings were high (Table 5), being above .90 for all stages in both sexes.

The distributions of age at reaching the various stages in breast development and in pubic hair development are shown in Figures 2 and 3, respectively, while the distributions of age at reaching the stages in boys' sexual development are shown in Figure 4. The means and standard deviations of each stage may be found in the appropriate figures. The average boy reached Sex Stage II at 11.8 years and attained the adult stage (Sex Stage V) at 15.2 years. Our average girl began Breast Stage II (elevated areola) at 10.6 years and reached the terminal stage (Breast Stage IV) at 13.9 years. Pigmented pubic hair, characteristic of our Hair Stage II, appears in girls at 11.6 years on the average, and Hair Stage IV, the latest reliably rated stage, is reached at 13.2 years by the typical girl in this study.

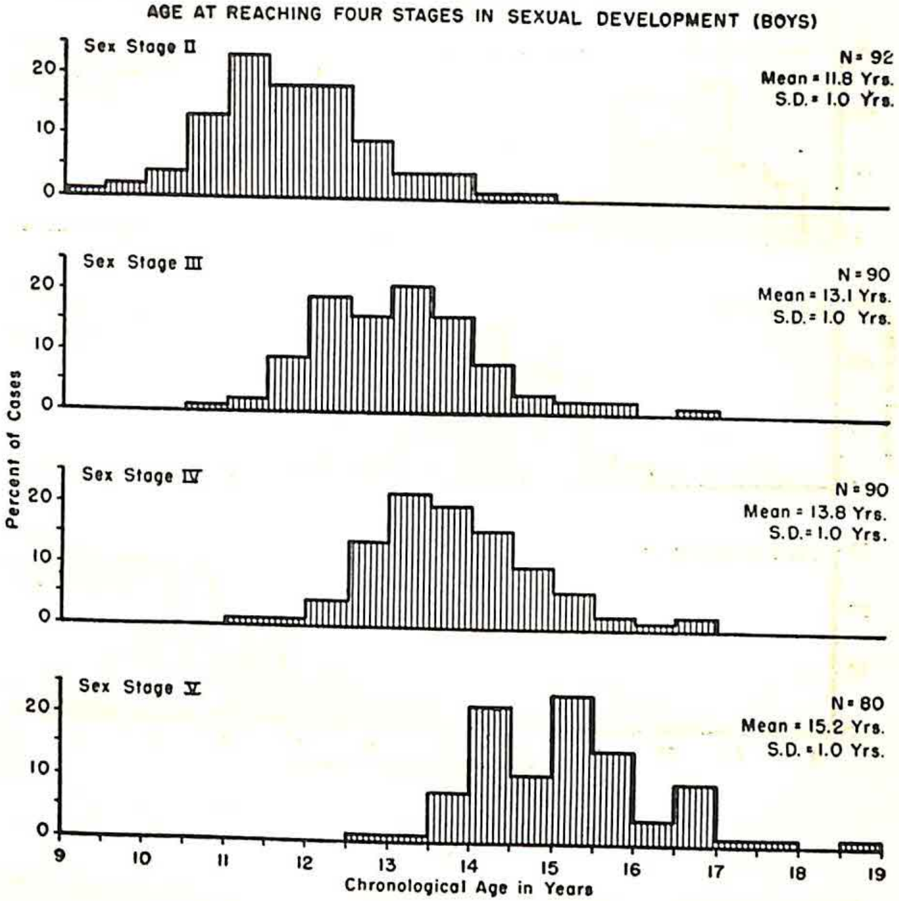

FIGURE 4

Skeletal Age Indices

Another index considered was skeletal age, or more specifically, the age at which various skeletal ages were reached. Skeletal ratings have frequently been used to distinguish early and late maturers (2, 7, 13).

X-rays of hand and knee, taken at half-yearly intervals from 8 to 18 years, had been rated[7] prior to this study according to the Todd standards, which are spaced at six-month intervals. Frequently, where an X-ray fell between standards in degree of maturity, ages were interpolated at approximately two-month intervals. For ease in statistical analysis, these ages were converted into decimals of a year. An individual's skeletal age then was found by averaging the hand and knee ages.

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[7] By Nancy Bayley and Ed Radsliff.

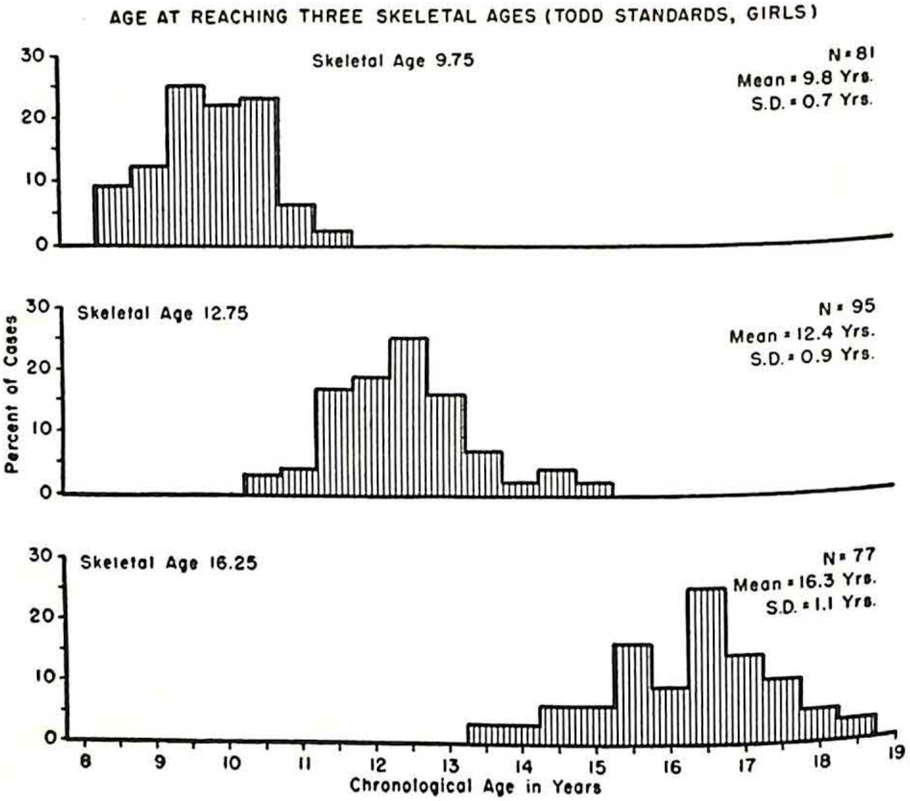

FIGURE 5

In order to arrive at a suitable skeletal index, it was necessary to find the average chronological age at which various skeletal ages were reached. The skeletal ages[8] used were chosen for the following reasons:

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[8] Finding the chronological age at which a stated Skeletal Age was reached involved interpolation of both skeletal and chronological ages by means of the following formula:

$$I = \frac{b'(a - R) + a'(R - b)}{a - b}$$

where

I is the interpolated chronological age at which a given Skeletal Age was reached,
R is the stipulated Skeletal Age,
a is the recorded Skeletal Age closest to and following R,
b is the recorded Skeletal Age closest to and preceding R,
a' is the chronological age at the time a was taken,
b' is the chronological age at the time b was taken.

This method does not require that a person be X-rayed at exactly half-yearly intervals. Interpolation intervals of both 1.00 and 1.30 years were calculated and compared. Because the differences were slight, all interpolations of intervals not exceeding 1.30 years were retained.

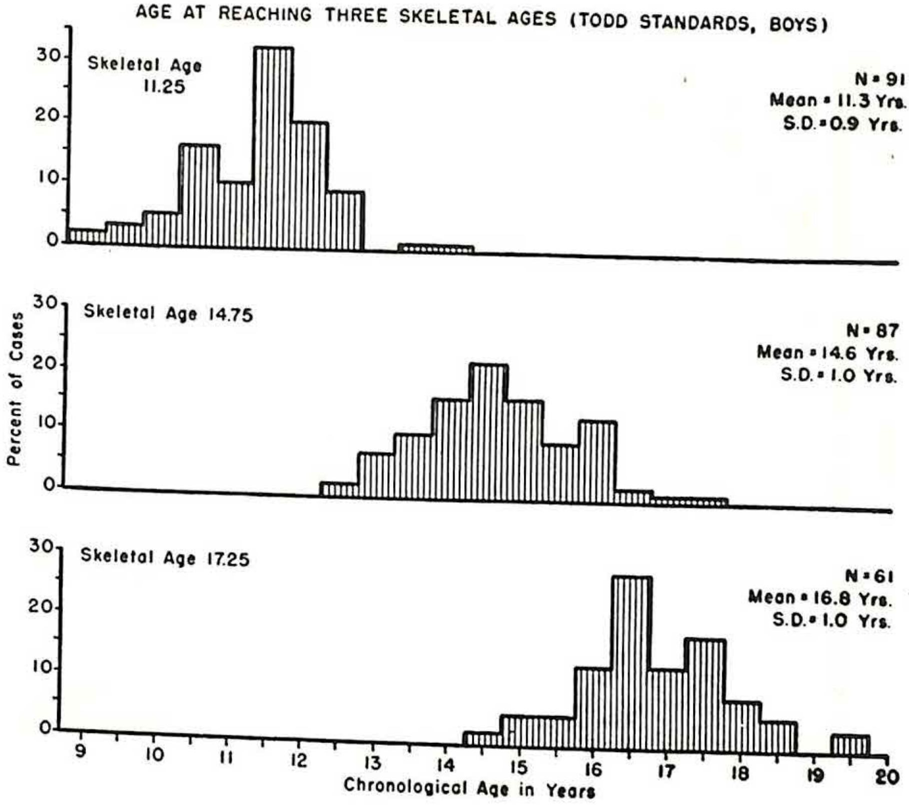

Figure 6

1. For girls, Skeletal Age 9.75 was the Skeletal Age which would reflect the growth status just prior to the maximum growth spurt. The equivalent Skeletal Age chosen for boys was 11.25.[9]

2. For girls, the next Skeletal Age was 12.75, an age close to the average chronological age at menarche. In boys, the developmentally equivalent age was selected, 14.75.

3. The final skeletal stage for girls was, by Todd standards, a Skeletal Age of 16.25. In boys, however, the Skeletal Age at which complete closure of the epiphyses occurs (18.75) was not used, because many of our cases had not attained this growth by the time routine data collection ceased. Following Bayley (2), Skeletal Age 17.25 was used as the final stage. This is so close to mature status that subsequent changes may be considered slight.

The means, standard deviations, and distribution of scores are shown in Figures 5 and 6. It should be noted that the largest discrepancy between a Skeletal Age and the corresponding chronological age occurs at the last stage in boys. This may indicate that the sample at these ages was curtailed on the Skeletal Age dimension. Some of the late maturers had not reached Skeletal Age 17.25 by 18 years when routine data collection ceased. Many of these individuals were seen a year or more later, but frequently they had by then reached skeletal maturity. In such cases the chronological age of skeletal maturity could not be ascertained; hence, no interpolation to find Skeletal Age 17.25 was possible. These considerations apply to certain other measures to be discussed. (See Section III.)

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[9] Based on unpublished developmental age equivalents made available to us by Dr. Nancy Bayley.

For boys, the chronological age at which Skeletal Age 11.25 was reached was compared with the Skeletal Age attained at a chronological age of 11.34 (the mean chronological age for 11.25) in order to see if these methods of handling the data were substantially different. The resulting correlation coefficient of +.94 indicates a high degree of agreement between the methods.

Per Cent of Mature Height

The use of Per Cent of Mature Height as a measure of maturity has several advantages and one major drawback:

1. It is based on growth in standing height, a relatively consistent measure (2, p. 31). The data on inter-age correlations for both sexes show consistent relationships between height at earlier ages and adult height, although the correlations for wide temporal spans are less than those for the late adolescent period.
2. The use of Per Cent of Mature Height rather than height itself gives a measure in which growth is relative to the individual, and actual size is disregarded.
3. This index may be related to similar data from the preadolescent period.
4. Per Cent of Mature Height cannot be calculated until growth in height has been completed.

Per Cent of Mature Height was obtained for each individual by determining the standing height measurement at the time of skeletal maturity, then calculating the percentage of this figure which occurred at any given age. Three types of mature height estimates were involved:

1. If height as measured fluctuated after skeletal maturity, an average of these fluctuating heights was designated "mature height."
2. If measurements continued to increase after skeletal maturity, the largest was designated "mature height."
3. If no mature X-ray had been taken, "mature height" was predicted using Bayley's tables (3). This was done for 35 per cent of boys and 15 per cent of girls.

On this basis, each boy's and girl's Per Cent of Mature Height at yearly and, after eight years, half-yearly intervals was calculated. In order to obtain scores comparable in form to the other indices, it was necessary to find the chronological age at which an individual reached certain stated per

TABLE 6

MEAN AGE OF REACHING VARIOUS PER CENTS OF MATURE HEIGHT

	BOYS			GIRLS		
Per Cent of Mature Height	*N*	*Mean Age*	*S.D.*	*N*	*Mean Age*	*S.D.*
45	72	1.3	.24	70	1.0	.19
50	66	2.2	.32	80	1.7	.22
55	84	3.3	.34	74	2.5	.34
60	87	4.6	.40	90	3.6	.36
65	88	5.9	.45	92	4.7	.41
70	86	7.3	.49	97	5.9	.47
75	83	8.9	.54	96	7.2	.52
80	92	10.6	.64	91	8.8	.58
85	90	12.3	.79	93	10.1	.68
90	89	13.7	1.04	93	11.4	.78
95	87	14.7	.98	91	12.5	.88
99	61	16.4	1.06	77	14.6	.90

cents of mature height. This involved the same method and formula for interpolation as presented for skeletal indices.[10]

An adequate number of cases was not available for normative purposes at ages earlier than 18 months. The first possible Per Cent of Mature Height in our data at 18 months was 45. The ages were calculated at which every fifth per cent increment was reached from 45 per cent on. The index, 99 per cent, was used rather than 100 per cent because growth is so slow at this time that rounding fractions to 100 per cent entailed the use of large age intervals giving possibly spurious results.

To compare the findings of this method of assigning Per Cent of Mature Height with those obtained by the more common practice of using the average Per Cent of Mature Height reached by a certain age, a test was made on girls' data:

1. Two determinations were made for each case. By interpolation the Per Cent of Mature Height at 12.44[11] was obtained and the mean calculated..
2. The chronological age at which each case reached 94.6 per cent (the mean Per Cent of Mature Height of chronological age 12.44) of mature height was determined by interpolation.

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[10] In this instance, some of the symbols take on new meanings:
R is the stipulated Per Cent of Mature Height,
a is the recorded Per Cent of Mature Height closest to but just higher than *R*,
b is the recorded Per Cent of Mature Height closest to but just lower than *R*.

[11] Used because it is the mean chronological age of Skeletal Age 12.75, one of our other standards.

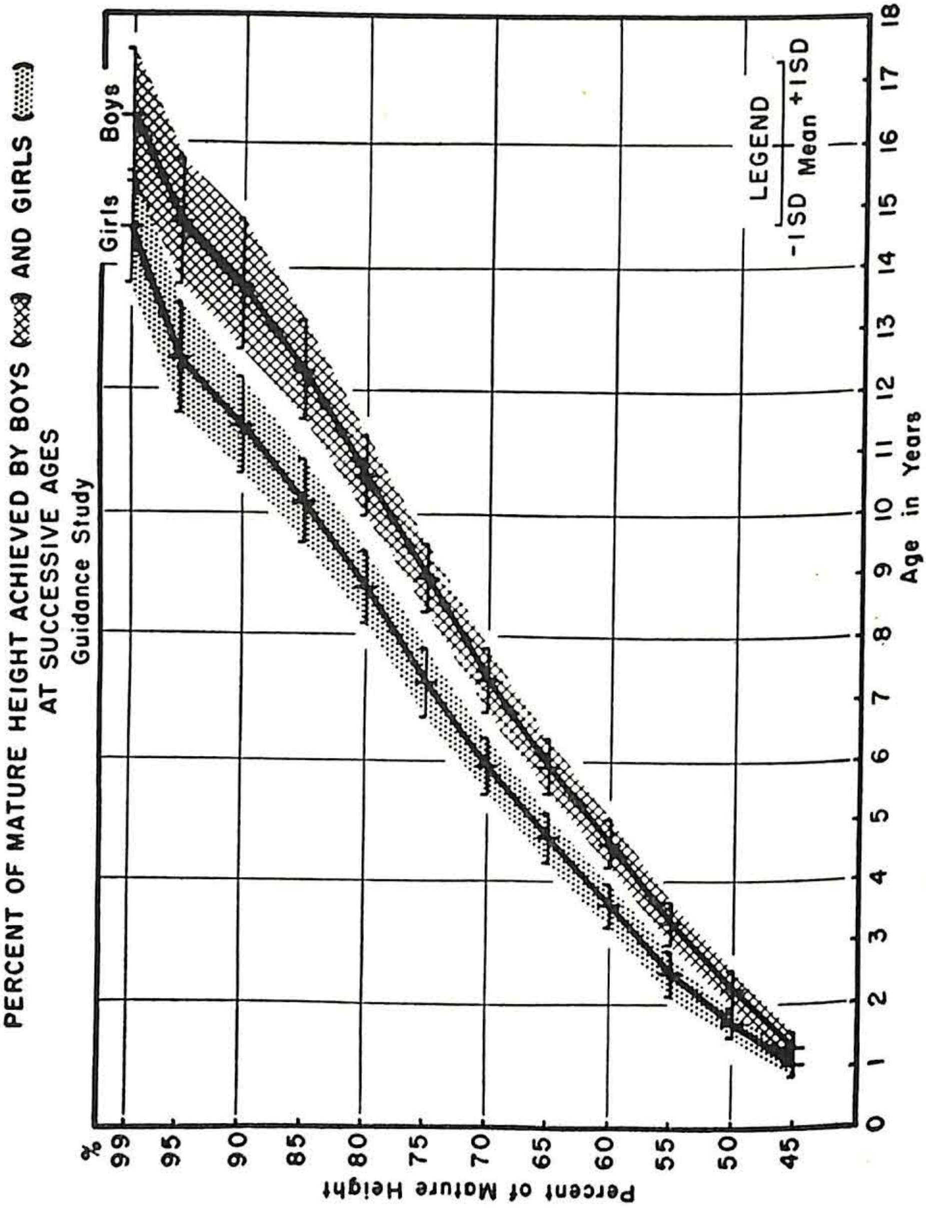
PERCENT OF MATURE HEIGHT ACHIEVED BY BOYS (xxx) AND GIRLS (....)
AT SUCCESSIVE AGES
Guidance Study
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FIGURE 7

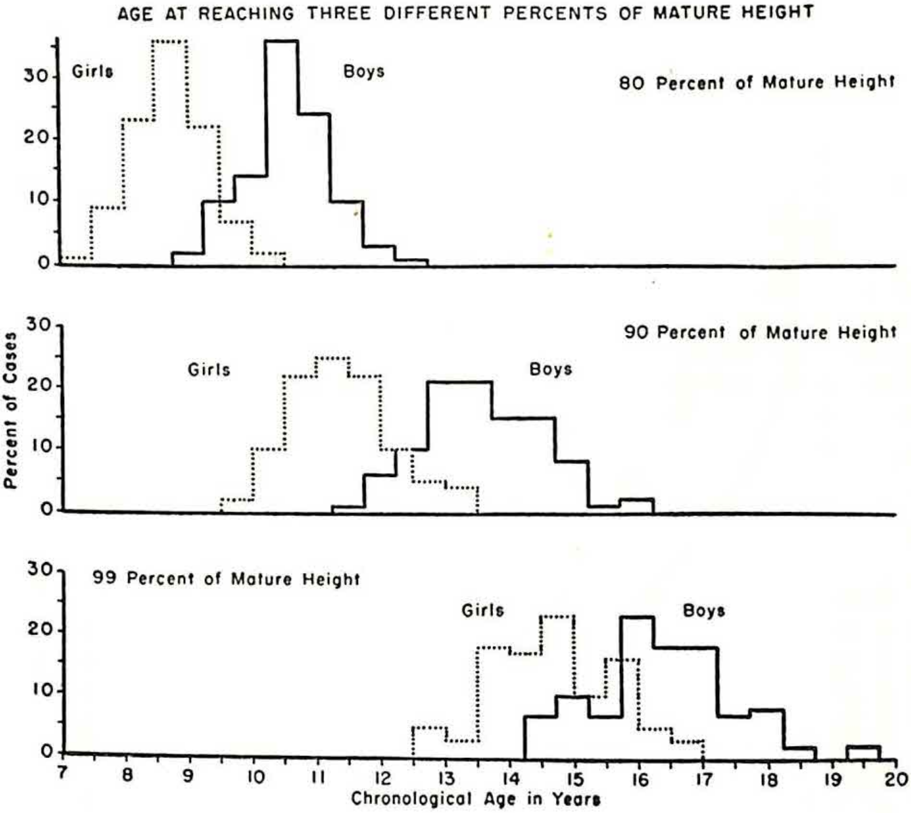

FIGURE 8

A correlation coefficient of +.97 between these two measures indicates substantial agreement between methods.

Data were used when the intervals (*a*) below two years of age were not greater than .5 years, (*b*) between two and three years were not larger than 1.1 years, (*c*) at all other ages were no larger than 1.25 years. The mean chronological ages for the various Per Cents of Mature Height are presented in Table 6. The norms at the late stages are liable to bias owing to the elimination of late maturers. (See Section III.)

Figure 7 gives a graphic portrayal of the course of growth in Per Cent of Mature Height for both sexes by means of "growth tracks" which clearly indicate the earlier maturing of the girls. Figure 8 presents the distributions of the scores of both sexes on three Per Cents of Mature Height which occur near to or during adolescence. These particular indices are included among those studied by means of the factorial analysis reported in Section II.

Age at Menarche

It has long been recognized that age at menarche "is the reflection of a physiological state which may occur at different times during the puberal

TABLE 7

AGE OF MENARCHE AS REPORTED IN VARIOUS STUDIES[*]

Studies	*N*	*Mean* (in years)	*S.D.*
Brush Foundation	200	12.6	1.1
Harvard Growth Study	248	13.0	1.1
Chicago Laboratory School	487	13.5	1.1
Hebrew Orphan Asylum	185	13.5	1.1
Horace Mann (Hebrew)	116	13.1	1.2
Horace Mann (Non-Hebrew)	236	13.1	1.2
Fels Institute	49	12.9	1.4
Present Study	91	12.8	1.1

[*] Abstracted from (2, p. 10).

period in different individuals and which usually precedes by a considerable interval the attainment of the capacity to reproduce" (5, p. 54). Although menarche itself cannot be considered an entirely satisfactory criterion of maturity (5, p. 2), it is readily obtainable, and because of its connection with endocrine factors, it is related to general physiological maturation.

In many studies a report of age at menarche is of necessity retrospective. In this longitudinal study the data were gathered shortly after the event.

TABLE 8

CORRELATIONS BETWEEN MENARCHE AND OTHER VARIABLES FROM THE GUIDANCE STUDY AND OTHER SOURCES

Variable Correlated with Menarche	*r*	*r*
Age at Maximum Growth	.71[*]	.70[§]
Skeletal Age 13.0	.84[*][†]	.85[‡][‖]
Breast Stage II	.74[*]	.86[¶]
Hair Stage II	.74[*]	.70[¶]

[*] Guidance Study.

[†] Skeletal Age 12.75.

[‡] Sign reversed to facilitate comparison.

[§] Shuttleworth (14).

[‖] Brush Foundation (15).

[¶] Reynolds and Wines (12).

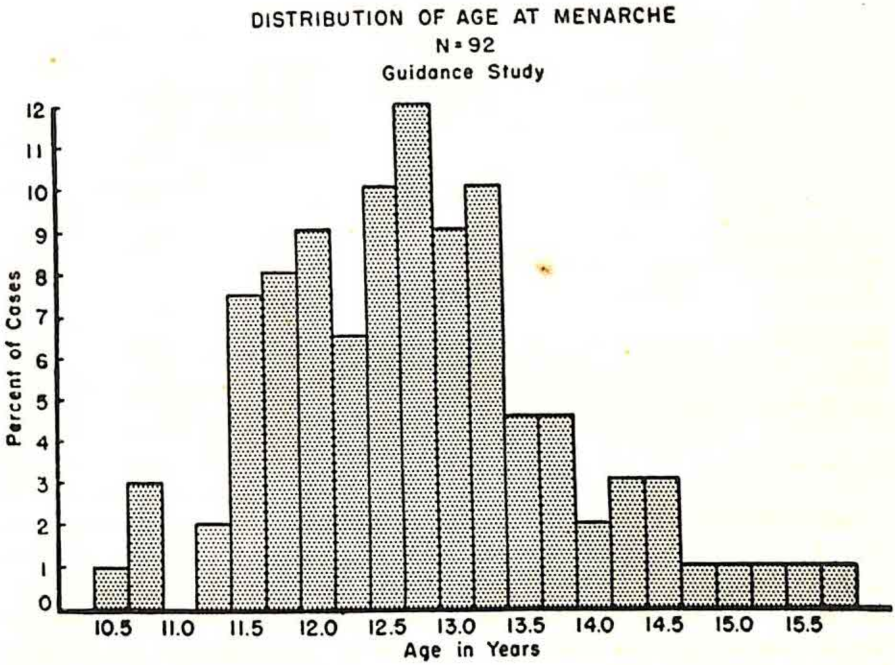

FIGURE 9

Our results are compared with those from other studies in Table 7, the 91 girls in this study having an average age at menarche of 12.8 years. The distribution of the individual ages is shown in Figure 9. The comparisons between different samples are interesting not only in regard to means, which vary from 12.6 years for the Brush Foundation sample to 13.5 for the Chicago Laboratory School and the Hebrew Orphan Asylum, but also in respect to the correlations between menarche and other growth variables shown in Table 8. The similarity between our results and those from other groups indicates the representativeness of our sample.

Age of Walking

It was our intention in this study to cover as wide an age range as was possible, hence we included data on Age of Walking, although current theory (4) would lead to the expectation that this variable would not correlate significantly with our other measures. Such proved to be the case, but the results are worth presenting in their own right. The data were obtained from records collected at the time the phenomenon occurred (11, p. 168).

The results are presented in Table 9 and are very similar to those reported elsewhere (1, 10). The mean Age of Walking for boys is 13.5 months and 13.6 months for girls. Table 10 shows several of the typically low correla-

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9.41

TABLE 9

MEAN AGE OF WALKING

Sex	*N*	*Mean Age* (months)	*S.D.*
Boys	114	13.5	2.1
Girls	123	13.6	2.1

tions obtained between Age of Walking and other growth variables, which indicated that Age of Walking should not be used in the matrices of intercorrelations which were factored as described in Section II.

Sex Differences

The differences between the sexes in rate of maturation have already been seen in those figures which permit direct comparison. In the one variable studied over the entire age span of the study, "Per Cent of Mature Height," the consistently earlier development of the girls is clearly shown (Figure 7). Sex differences increase with each increase in chronological age until 90 Per Cent of Mature Height is reached. The mean age at that level for boys is 13.7 years, for girls 11.4 years, the difference being two and one-third years. After this level differences tend to become smaller.

TABLE 10

CORRELATION BETWEEN AGE OF WALKING AND OTHER INDICES

Index Correlated with Age of Walking	*N*	*r*
Boys:		
Age at Maximum Growth	85	—.05
45 Per Cent of Mature Height	70	.01
Skeletal Age 11.25	89	—.21
Sex Stage II	92	—.19
90 Per Cent of Mature Height	89	—.12
Girls		
Age at Maximum Growth	87	.22
45 Per Cent of Mature Height	70	—.05
Skeletal Age 9.75	81	.19
Breast Stage II	78	.17
90 Per Cent of Mature Height	93	.02
Hair Stage II	91	.12

These differences, however, are affected by the fact that mature girls not only finish growing earlier than mature boys, but also are shorter than the boys. Until chronological age 12 years, on the other hand, the average girl and boy in this sample have virtually the same height. The numerator of the fraction which determines Per Cent of Mature Height at a given age prior to 12 years, therefore, is likely to be the same for both sexes, but the denominator (terminal height) is quite different for boys and girls. Nevertheless, the relationships between the early Per Cents of Mature Height and other measures of maturation indicate the validity of the former index.

Age at Maximum Growth, a variable which is independent of the disparity in the terminal heights of the sexes, is a better measure of the earlier maturation of the girls. Maximum growth occurs on the average at 11.5 years in girls and at 13.8 years in boys, a difference of two and one-third years between the sexes.

No comparison is possible for Skeletal Age scores, since the standards are different for the sexes. The same is true in respect to ratings of sexual development, but the first discernible signs of external sexual change occur at 10.6 years in girls and not until 11.8 years, on the average, in boys. The difference between the means is one and one-quarter years in this case.

These differences between the sexes are consistent with the reports in the literature. With the exception of age of walking, sex comparisons indicate that the girls mature earlier than the boys from 21 months to 18 years.

Individual Growth Records

For summary presentation of the entire growth records of individuals, growth charts were devised for boys and girls. (See Figures 10 and 11.) An individual's record plotted on one of these charts shows at a glance his standing with respect to his group and his own variability, if any, among the measures used.[12]

II. Interrelations of Indices

In view of the fact that different workers have used various single measures as indicative of maturity, it seemed important to check the relationships among these measures and to determine the generality of the adolescent growth phenomenon. A factorial analysis of correlations between our variables should lead to a clear statement of generality. Such an analysis would, in addition, facilitate making optimal use of data in assigning maturity scores to individuals. Two questions needed answering in this connection. First, how much of the variance in the measures could be attributed to the operation of a general factor? Second, how well did each index measure this factor?

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[12] These 11″ x 17″ charts lose visual clarity when reduced to journal page size.

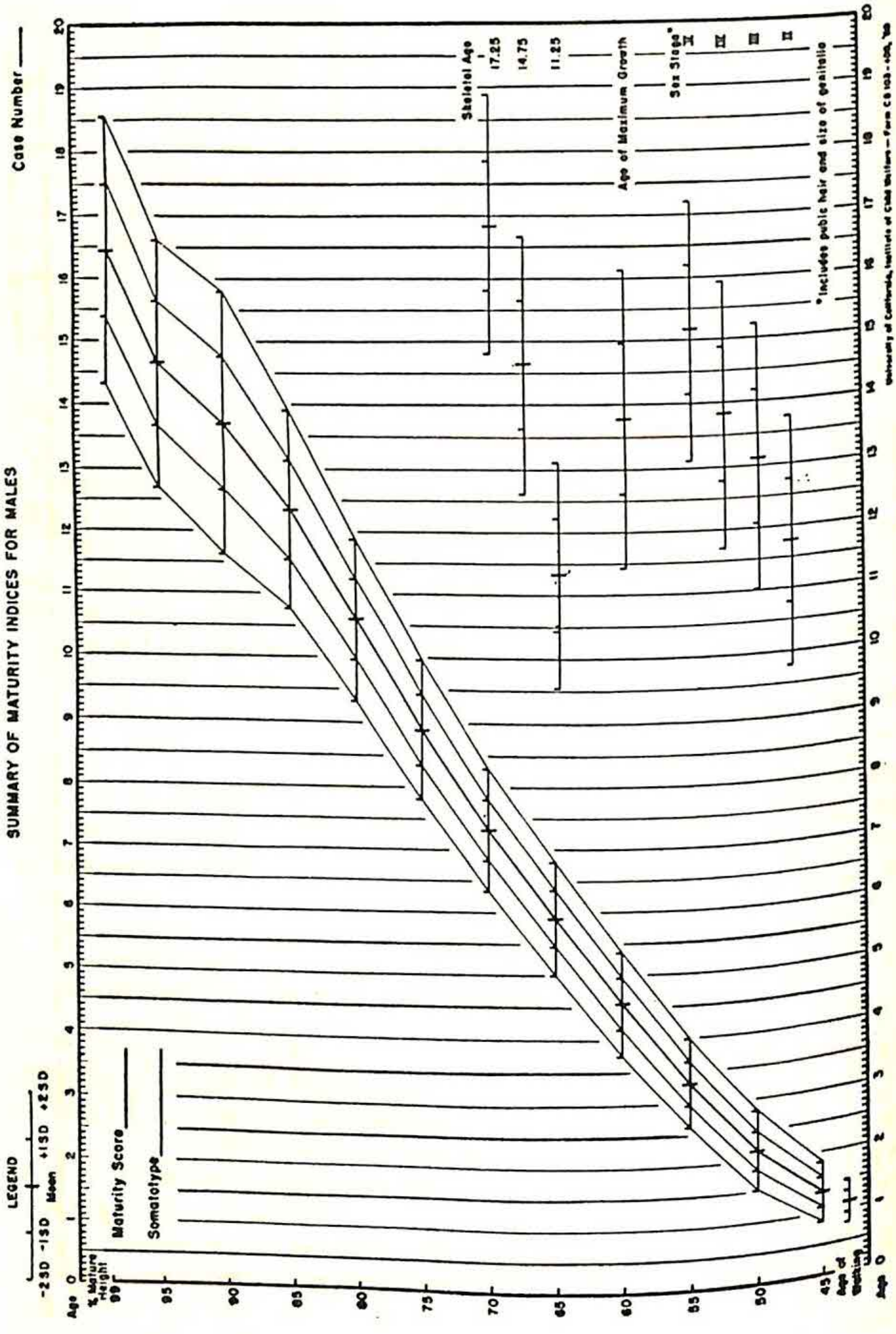
SUMMARY OF MATURITY INDICES FOR MALES
Case Number ____
LEGEND
-2SD -1SD Mean +1SD +2SD
Maturity Score
Somatotype
Age
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
% Mature Height
99
95
90
85
80
75
70
65
60
55
50
45
Age of Walking
Skeletal Age
17.25
14.75
11.25
Age of Maximum Growth
Sex Stage*
V
IV
III
II
*Includes pubic hair and size of genitalia
University of California, Institute of Child Welfare — Form C S 103 - 106, '50

FIGURE 10

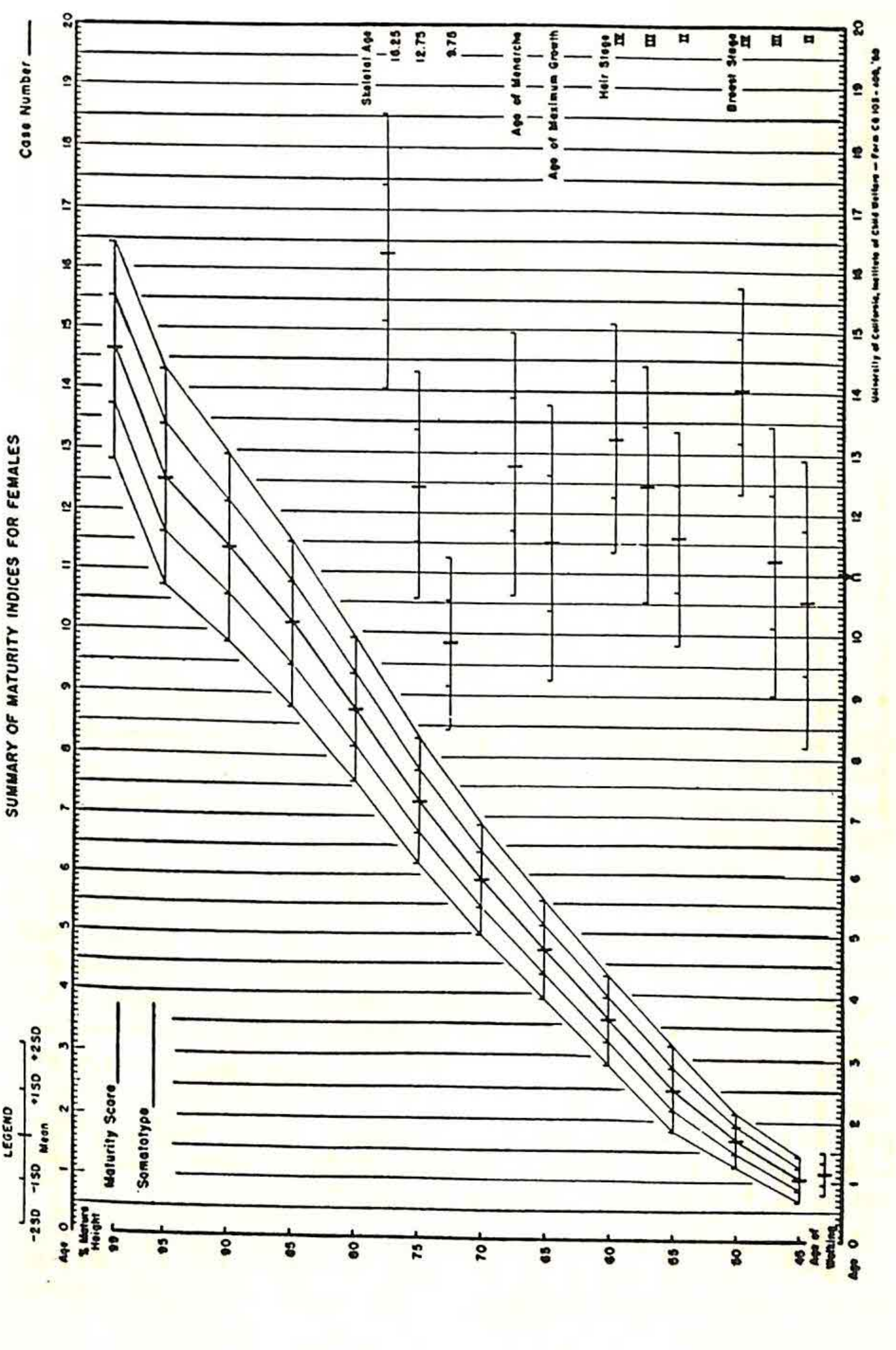
SUMMARY OF MATURITY INDICES FOR FEMALES
Case Number ___
LEGEND
-2SD -1SD Mean +1SD +2SD
Maturity Score
Somatotype
Age 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
% Mature Height
99
95
90
85
80
75
70
65
60
55
50
45
Age of Walking
Skeletal Age
16.25
12.75
9.75
Age of Menarche
Age of Maximum Growth
Hair Stage
IV
III
II
Breast Stage
IV
III
II
University of California, Institute of Child Welfare

FIGURE II

Correlation matrices of boys' and girls' indices were factored using Spearman's formula.[13] The procedures and results will be described separately for each sex.

Girls' Matrix

Fourteen indices were computed for each girl from the following measures of adolescent maturation:

Age at Menarche
Age at Reaching Breast II —Elevated areola
Age at Reaching Breast III—Small mound formation
Age at Reaching Breast IV—Terminal stage of breast contour
Age at Reaching Hair II —Pigmented, straight hair. Sparse amount
Age at Reaching Hair III—Curled hair. Larger amount
Age at Reaching Hair IV—Moderate amount and spread of hair
Age at Maximum Growth
Age at Reaching Skeletal Age 9.75
Age at Reaching Skeletal Age 12.75
Age at Reaching Skeletal Age 16.25
Age at Reaching 80 Per Cent Mature Height
Age at Reaching 90 Per Cent Mature Height
Age at Reaching 99 Per Cent Mature Height

Two of these stages (9.75 and 80 Per Cent of Mature Height) occur in the early stages of adolescence. The correlations based on chronologically late measures (99 Per Cent of Mature Height and Skeletal Age 16.25) possibly were lowered through the elimination of late maturers from these groups. (See Section III.)

Owing to difficulties involved in longitudinal studies, the coefficients between each pair of tests were based on varying numbers of children. It would have been possible to select a core group, but such a sample would have been small. Since no systematic factors related to physical maturation appeared responsible for an individual's missing an appointment, it was believed that a better estimate of the population values could be obtained by using all the available cases; therefore, in calculating the correlation between any two indices, all the data were used. This did not preclude the possibility of curtailment affecting the terminal indices, but it restricted such effects to the later indices, whereas forming a "core" group would have affected every index in the factor matrix.

The matrix of intercorrelations is shown in Table 11 together with the number of cases for each coefficient. Table 12 presents the residuals after Factor A had been extracted. Some of these appear significantly different

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[13] (16) Formula 21, Appendix.

TABLE 11

GIRLS' MATRIX

(Number of cases for each coefficient shown in parentheses)

	B-II	B-III	B-IV	H-II	H-III	H-IV	MGA	9.75	12.75	16.25	80%	90%	99%
	r	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*
Menarche	.741 (68)	.755 (83)	.709 (84)	.739 (79)	.715 (81)	.688 (78)	.710 (82)	.638 (69)	.845 (87)	.587 (73)	.687 (80)	.861 (83)	.719 (74)
Breast Stage II	...	.930 (76)	.747 (69)	.752 (74)	.635 (69)	.575 (64)	.797 (65)	.719 (70)	.822 (72)	.602 (59)	.660 (71)	.849 (72)	.711 (62)
Breast Stage III	...	...	.780 (84)	.755 (86)	.742 (84)	.664 (78)	.670 (80)	.673 (73)	.824 (88)	.595 (72)	.664 (82)	.847 (87)	.675 (74)
Breast Stage IV	...	...	...	.648 (80)	.694 (83)	.642 (79)	.577 (84)	.658 (66)	.725 (87)	.598 (75)	.642 (80)	.754 (85)	.663 (77)
Hair Stage II	...	...	...	...	.885 (83)	.823 (77)	.747 (77)	.688 (72)	.812 (84)	.660 (68)	.650 (79)	.798 (85)	.706 (70)
Hair Stage III	...	...	...	...	...	.909 (81)	.688 (80)	.660 (69)	.813 (86)	.713 (72)	.711 (81)	.810 (84)	.684 (73)
Hair Stage IV	...	...	...	...	...	...	.640 (79)	.615 (64)	.734 (82)	.614 (72)	.602 (80)	.696 (81)	.617 (72)
Age Max. Growth	...	...	...	...	...	...	...	.686 (66)	.805 (86)	.594 (73)	.639 (80)	.837 (82)	.724 (74)
Skel. Age 9.75	...	...	...	...	...	...	...	...	.781 (73)	.669 (57)	.747 (69)	.745 (70)	.728 (59)
Skel. Age 12.75	...	...	...	...	...	...	...	...	...	.769 (76)	.793 (84)	.931 (88)	.785 (77)
Skel. Age 16.25	...	...	...	...	...	...	...	...	...	...	.705 (82)	.736 (75)	.643 (71)
80% Mat. Height	...	...	...	...	...	...	...	...	...	...	...	.856 (86)	.745 (72)
90% Mat. Height	...	...	...	...	...	...	...	...	...	...	...	...	.851 (77)
99% Mat. Height	...	...	...	...	...	...	...	...	...	...	...	...	...

from zero, provided the formula $r = (1 - r^2)/N$ is applied, a procedure suggested by Thompson (18, p. 156). It has been pointed out in other contexts, however, that this formula is an approximation which is misleading when the number of cases is small and the population value of the correlation coefficient is large (9, p. 123), conditions which seem to apply here. When the residuals in Table 12 are transformed into z's, none is signifi-

TABLE 12

RESIDUALS FROM GIRLS' MATRIX

	B-II	B-III	B-IV	H-II	H-III	H-IV	MGA	9.75	12.75	16.25	80%	90%	99%
Men.	.006	.017	.032	−.006	−.030	.013	.011	−.053	.034	−.061	−.011	.039	.008
B-II	...	.180	.059	−.006	−.122	−.111	.086	.017	−.002	−.056	−.050	.013	−.012
B-III	...	...	.089	−.006	−.018	−.025	−.044	−.032	−.003	−.066	−.049	.008	−.050
B-IV	...	...	...	−.050	−.003	.010	−.078	.011	−.034	−.008	−.012	−.015	−.002
H-II	...	...	...	...	.117	.127	.026	−.024	−.024	−.008	−.070	−.050	−.027
H-III	...	...	...	...	...	.213	−.033	−.052	−.022	.046	−.009	−.037	−.049
H-IV	...	...	...	...	...	...	−.013	−.030	−.023	.009	−.050	−.072	−.047
AMG	...	...	...	...	...	...	...	.018	.020	−.033	−.037	.041	.036
9.75	...	...	...	...	...	...	...	...	.006	.050	.080	−.041	.049
12.75	...	...	...	...	...	...	...	...	...	.043	.010	.009	−.012
16.25	...	...	...	...	...	...	...	...	...	...	.079	−.001	.006
80%	...	...	...	...	...	...	...	...	...	...	...	.062	.058
90%	...	...	...	...	...	...	...	...	...	...	...	...	.043
99%	...	...	...	...	...	...	...	...	...	...	...	...	...

cantly different from zero at the 1 per cent level.[14] This, however, does not exclude the possibility that more than one factor is operating, since the same residuals might have appeared if a larger number of persons were used and thereby become significant. It did indicate that taking out further factors risked factoring chance variation. In this connection, also, the variation in the size of the group should be remembered.

The factor loadings and communalities are given in Table 13. Each communality may, by suitably changing the decimal point, be read as the percentage of the total variance of the index associated with the growth factor. It will be seen that this factor accounts for well over half of the variance of each index.

---

[14] This is a stringent criterion. Actually, at a later date we extracted two additional factors and rotated the loadings orthogonally until the negative loadings disappeared. The new factors measured primarily pubic hair development and breast development in addition to a general factor. The amount of variance associated with the general factor is reduced, to be sure, but not eliminated in any variable by rotation. It would seem that "simple structure" does not apply to this matrix, hence it is desirable to have the general factor account for as much variance as possible. For this reason, in addition to the question of significance, we used the results of the Spearman analysis.

TABLE 13

GIRLS' FACTOR LOADINGS

Index	*Factor Loading**	*Communality*†
Menarche	.850	.722
Breast Stage II	.864	.746
Breast Stage III	.868	.753
Breast Stage IV	.796	.634
Hair Stage II	.877	.769
Hair Stage III	.876	.767
Hair Stage IV	.794	.630
Age at Maximum Growth	.823	.677
Skeletal Age 9.75	.812	.659
Skeletal Age 12.75	.954	.910
Skeletal Age 16.25	.762	.581
80 Per Cent of Mature Height	.822	.676
90 Per Cent of Mature Height	.967	.935
99 Per Cent of Mature Height	.836	.699

* Correlation between index and general factor.

† Proportion of variance in index associated with general factor.

From the results of the factorial analysis, it is possible to evaluate the approximate efficiency of the indices as measures of adolescent maturation, the criterion for this evaluation being based on the interrelationships between the indices themselves.

In the girls' matrix there were measures drawing on five areas of development: Menarche, Pubic Hair, Breast, Skeleton, and Stature. Within each of these areas there are measures with high loadings, no one area having a monopoly in this respect. Ninety Per Cent of Mature Height has the highest loading, followed in descending order by Skeletal Age 12.75, Hair Stages II and III, Breast Stages III and II, and Age at Menarche. From consideration of the results in Table 13, it appears that 90 Per Cent of Mature Height is the best single measure of adolescent maturation of girls, with Skeletal Age 12.75 not far behind. Several of the other indices, however, are almost as good. Hair Stages II and III, and Breast Stages II and III, for example, have as high loadings as measures which have more commonly been used as indices, e.g., Age at Maximum Growth and Menarche. These latter, however, have high loadings, and if they were used in connection with the extremes of distributions, as seems to be the typical practice, the results would be quite similar to those obtaining with the slightly more efficient indices. When longitudinal data over a fairly wide temporal span are not available and the use of Age at Maximum Growth or Per Cent of Mature Height indices thereby ruled out, Hair, Breast, or Skeletal indices appear to be satisfactory substitutes.

Boys' Matrix

This matrix consisted of the intercorrelations between 11 indices previously described in Section I:

Age at Reaching Sex II —Increase in size of penis and testes
Age at Reaching Sex III—Straight, pigmented pubic hair
Age at Reaching Sex IV—Pubic hair adult in appearance but not in area
Age at Reaching Sex V —Genitalia adult in size and shape, pubic hair adult
Age at Maximum Growth
Age at Reaching Skeletal Age 11.25
Age at Reaching Skeletal Age 14.75
Age at Reaching Skeletal Age 17.25
Age at Reaching 80 Per Cent Mature Height
Age at Reaching 90 Per Cent Mature Height
Age at Reaching 99 Per Cent Mature Height

TABLE 14

BOYS' MATRIX

(Number of cases for each coefficient shown in parentheses)

	Sex-III r	Sex-IV r	Sex-V r	MGA r	11.25 r	14.75 r	17.25 r	80% r	90% r	99% r
Sex Stage II	.799 (89)	.788 (88)	.599 (77)	.665 (85)	.349 (88)	.689 (85)	.650 (58)	.380 (89)	.728 (87)	.644 (59)
Sex Stage III	...	.944 (89)	.762 (78)	.769 (86)	.455 (87)	.800 (85)	.799 (59)	.485 (88)	.802 (88)	.736 (60)
Sex Stage IV	...	...	.821 (79)	.814 (86)	.412 (87)	.685 (78)	.839 (60)	.533 (88)	.872 (89)	.771 (60)
Sex Stage V	...	...	...	.705 (78)	.342 (78)	.693 (78)	.735 (55)	.507 (79)	.739 (79)	.752 (57)
Age at Max. Growth .	...	...	...	...	.308 (83)	.834 (84)	.832 (57)	.620 (84)	.903 (85)	.819 (59)
Skeletal Age 11.25 ..	...	...	...	...	...	.515 (83)	.372 (58)	.605 (89)	.471 (86)	.267 (58)
Skeletal Age 14.75 ..	...	...	...	...	...	...	.928 (59)	.722 (85)	.951 (85)	.869 (59)
Skeletal Age 17.25 ..	...	...	...	...	...	...	...	.769 (59)	.942 (60)	.900 (56)
80% Mat. Height ..	...	...	...	...	...	...	...	...	.768 (88)	.711 (59)
90% Mat. Height ..	...	...	...	...	...	...	...	...	...	.927 (60)
99% Mat. Height ..	...	...	...	...	...	...	...	...	...	...

Table 15

RESIDUALS FROM BOYS' MATRIX

	Sex-III	Sex-IV	Sex-V	MGA	11.25	14.75	17.25	80%	90%	99%
Sex Stage II	.136	.112	.005	.010	–.003	–.008	–.055	–.160	–.012	–.023
Sex Stage III	...	.140	.056	–.009	.037	–.029	–.039	–.156	–.078	–.057
Sex Stage IV	...	...	.101	.021	–.014	–.160	–.016	–.121	–.025	–.038
Sex Stage V	...	...	...	.008	–.032	–.049	–.015	–.067	–.049	.042
Age at Max. Growth	...	...	...	...	–.105	.016	.004	–.013	.034	.036
Skeletal Age 11.25	...	...	...	...	...	.075	–.073	.265	.004	–.154
Skeletal Age 14.75	...	...	...	...	...	...	.047	.048	.026	.035
Skeletal Age 17.25	...	...	...	...	...	...	...	.087	.006	.057
80% Mat. Height	...	...	...	...	...	...	...	...	.052	.066
90% Mat. Height	...	...	...	...	...	...	...	...	...	.041
99% Mat. Height	...	...	...	...	...	...	...	...	...	...

It included indices presumably preceding and following adolescence, i.e., Skeletal Age 11.25 and 99 Per Cent Mature Height. A boy's "score" was the chronological age of reaching each stage. As was the case with the girls, the coefficients were not based on the same number of cases in each instance, and curtailment due to the elimination of late maturers may have lowered the correlations with 99 Per Cent Mature Height, Skeletal Age 17.25 and Sex V. (See Section III.)

Table 14 shows the intercorrelations among boys' indices. The table was factored by the same method used for the girls'. The residuals after the first factor was extracted are shown in Table 15. None is significant at the 1 per cent level using the *z*-test. On this basis, therefore, no further factors were extracted, but the remarks made in connection with the girls' matrix apply here, i.e., significant residuals leading to additional factors might appear if the group were larger. The factor loadings of each measure are given in Table 16. The communalities of most of these tests are high and quite comparable with those obtained for the girls. Three measures, however, have relatively low communalities: Sex II, Skeletal Age 11.25, and 80 Per Cent of Mature Height. It will be seen that these represent the chronologically earliest ages in the matrix. The residual between 80 Per Cent and Skeletal Age 11.25 comes closest to the 1 per cent level of significance, suggesting a possible group factor in these two tests.[15]

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[15] When these two variables are eliminated from the matrix and the analysis repeated, the two largest residuals are .151 and .113.

TABLE 16

BOYS' FACTOR LOADINGS

Index	*Factor Loading**	*Communality*†
Sex Stage II	.747	.558
Sex Stage III	.888	.789
Sex Stage IV	.905	.819
Sex Stage V	.795	.632
Age at Maximum Growth	.877	.769
Skeletal Age 11.25	.471	.222
Skeletal Age 14.75	.934	.872
Skeletal Age 17.25	.944	.891
80 Per Cent of Mature Height	.722	.521
90 Per Cent of Mature Height	.991	.982
99 Per Cent of Mature Height	.894	.799

* Correlation of index with general factor.

† Proportion of variance in index associated with general factor.

As was true for girls, all of the variables have substantial loadings on a general factor of adolescent growth. This result is not surprising, since the indices selected have been held by others to be strongly influenced by endocrine changes associated with adolescence. Not all of the measures, however, were equally affected by this factor. The boys' matrix had measures from three developmental areas: Sexual Characteristics, Stature, and Skeleton. Each area had indices with high loadings, a further indication of the generality of adolescent growth. The fact that the chronologically earliest measures in each area, i.e., Sex II, 80 Per Cent of Mature Height, and Skeletal Age 11.25, have the lowest loadings may indicate that these indices occur before the endocrine effects are at a maximum. The highest factor loadings occur in measures taken around the age of 14; 90 Per Cent of Mature Height, for example, has a factor loading of .99.

Derivation of Maturity Scores

With the completion of our first two tasks, namely, the determination of the degree of generality in adolescent growth and the assessment of relative efficiencies of the various single measures of maturation, the third objective, the derivation of an over-all "maturity score" for individuals was possible. To obtain a summary figure representing the rate of physiological maturing during the adolescent period, multiple regression equations were used. The general factor became the criterion variable which was to be predicted from a knowledge of its correlations with (loadings in) the maturity indices. The multiple regression equations gave the best weights to be used for tests in combinations which were to predict the criterion, and the multiple correlations between these combinations and the general factor indicated how well each combination performed. The Doolittle (9, p. 157) method was followed to obtain the weights. It was necessary to use only three tests to obtain very high correlations with the criterion.

Girls' scores. Most of the girls' maturity scores were based on a weighted combination of Skeletal Age 12.75, 90 Per Cent of Mature Height, and Hair II. The multiple correlation of this combination with the maturity factor is .99. When one or more of these particular indices were not available for a given girl, a regression equation utilizing other indices was computed and weights found for these new tests. The correlations between these various combinations and maturity range from .90 to .98. The scores from the use of each of these multiple regression equations were obtained in standard score form. They represent an estimate of adolescent physiological maturity embodied in a single score. In 101 girls, the Adolescent Maturity Score has a range from 22 to 70 with a mean at 50 and a standard deviation of 10.

Boys' Scores. Since the correlation between 90 Per Cent of Mature Height of boys and the maturity factor was .99, standard scores on the former were used as the Adolescent Maturity Scores for this group. In the few instances where no 90 Per Cent of Mature Height determination was available, multiple regression equations were used in the same manner as with the girls. The multiple correlations between these combinations and the maturity factor varied from .95 to .99. The Adolescent Maturity Scores of the 92 boys range from 27 to 71 with a mean at 50 and a standard deviation of 10.

III. Evaluation of Results

The maturity scores make possible an evaluation of the effect of curtailment on the maturity dimension of the samples used in norming the girls' terminal indices. The mean Maturity Scores were computed for girls included in and excluded from our Skeletal Age 16.25 and 99 Per Cent of Mature Height groups. On both measures the means of the omitted group were lower (later maturing), but the differences were not significant at the 5 per cent level. These results indicate that there was no significant loss of late-maturing girls because of the termination of routine data collection at 18. Confirmation is found in the fact that the mean chronological age for Skeletal Age 16.25 is 16.28. Such close agreement would not be expected if late-maturing girls had been eliminated from the sample, unless, of course, Berkeley girls mature later than Todd's sample. Somewhat different results were found in this connection with the boys.

The boys' Maturity Scores were similarly used to study the possible curtailment of the later indices. The means of the cases omitted from two of the terminal measures, i.e., Skeletal Age 17.25 and 99 Per Cent of Mature Height, were lower (later maturing) than those from the norming samples for these measures,[16] and these differences were statistically significant at the 1 per cent level. This clearly indicates that the norms for these indices are biased because of the elimination of late-maturing boys from the sample, a fact to be kept in mind when utilizing these findings for comparative purposes.[17] This bias also affected the factor loadings to some extent, since it may have resulted in the attenuation of the correlations involving these two variables, i.e., higher correlations would be found if the full sample had been used. The factorial results for boys, therefore, seem less reliable than those for girls.

Table 17

CORRELATIONS BETWEEN MATURITY SCORES AND PRE-PUBESCENT MEASURES

	Girls		Boys	
Pre-Pubescent Variable	*N*	*r*	*N*	*r*
50 Per Cent of Mature Height	74	.48	64	.24
55 Per Cent of Mature Height	71	.54	81	.36
65 Per Cent of Mature Height	89	.64	85	.58

The variables in the correlation matrices covered the period of adolescence, but the possibility remained that measures taken prior to pubescence would correlate significantly with the Maturity Score. Unfortunately, indices were available in only a single developmental area (other than age of walking) earlier than the ninth year: *Per Cent of Mature Height.* Three of the earlier Per Cents of Mature Height were correlated with the Maturity Scores of boys and girls to determine whether individual differences in early growth were related to those characteristic of adolescence. These correlations appear in Table 17, all but one being significant at the 1 per cent level, the exception (50 Per Cent of Mature Height, boys) at the 5 per cent level. Individual differences at early ages, it appears, are significantly related to adolescent maturation. The extent of these relationships, however, ranges from moderate to small. The correlations for girls are higher at each Per Cent of Mature Height level, a fact which tends to support the belief that the results from the girls' matrix are more reliable than those from the boys'.

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[16] Sex V was not affected by curtailment.

[17] The difference between the chronological age at which our boys reach Skeletal Age 17.25 and the Todd standard is in keeping with this finding. (See Figure 6.)

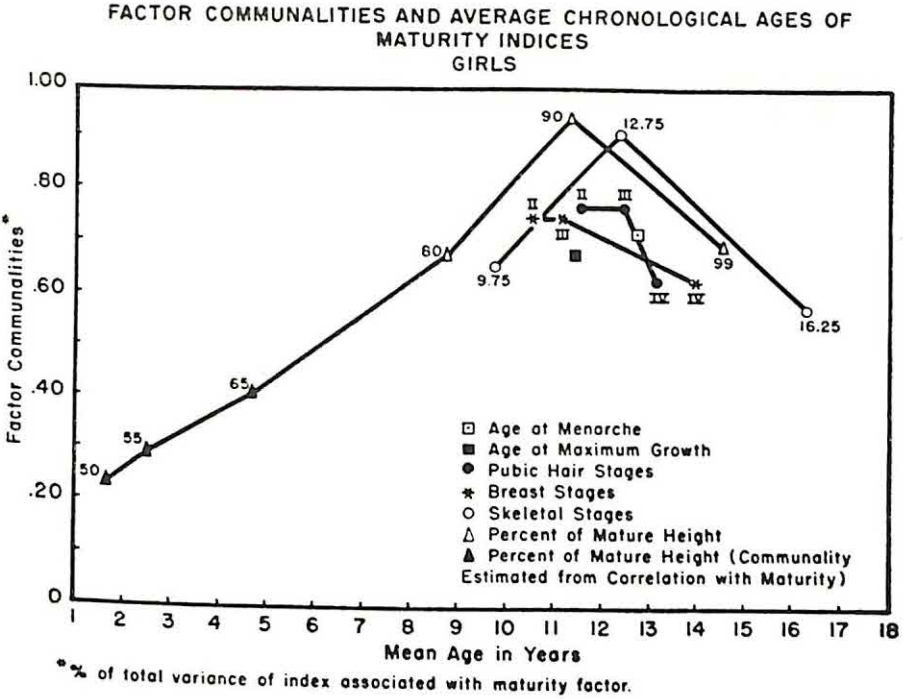
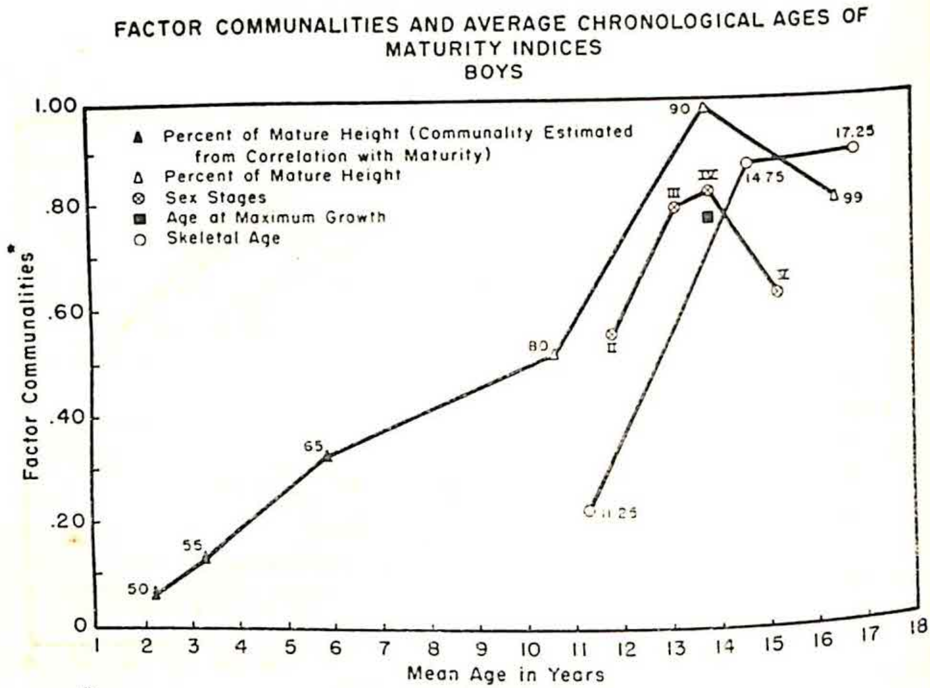


FIGURE 12

The factor communalities, i.e., squared factor loadings, of each variable in the matrices are shown graphically in Figures 12 and 13. The communalities for the early Per Cents of Mature Height were arrived at by using their correlations with Maturity Score as estimates of their factor loadings. Measures in a single developmental area are linked together in these figures. The highest communalities occur among the girls' measures taken between the 11th and 13th year; in boys, the high points of the curves center around year 14. There is a pronounced tendency for the communalities to become lower as they become temporally more remote from these centering points. This, of course, is a function of the selection of measures in these matrices. Measures taken at a given age level in different developmental areas tend to have factor communalities of approximately the same size. This, it woud seem, is a clear indication that earliness or lateness on a given measure at a particular age level during adolescence is a function of the general maturational status at the time.

Useful predictions of individual adolescent maturation could not, of course, be made from the early Per Cents of Mature Height. The correlations are too low, and Per Cent of Mature Height cannot be calculated until terminal height is reached. Prepubescent skeletal age, however, might provide a useful prediction, but X-rays were not taken before eight years.



*% of total variance of index associated with maturity factor

FIGURE 13

The shape of the Skeletal Age curve in Figure 12 is very similar to that for the Per Cent of Mature Height measures. In Figure 13, however, Skeletal Age 11.25 has a factor communality much lower than other measures taken at nearby ages. It is difficult to determine the reason for this discrepancy, since reliability figures for this particular datum are not available. Skeletal Age 17.25 in Figure 13 has a higher communality than would be expected on the basis of the results in Figure 12 or from the other curves on Figure 13, which show the terminal stages to have lower communalities than earlier stages in a given area. It is possible that Skeletal Age has a different relationship to adolescent development in boys than in girls, but the data from the factorial analysis in this study are not suitable for settling this problem, since the terminal boys' measures were curtailed on the maturational dimension.

SUMMARY

1. Various measures of physiological maturity and their rationale are described. Data are reported for a representative, urban sample of approximately 180 boys and girls who were measured annually from their first to their eighth year of life and semi-annually thereafter until they were 18 years of age.

2. Age norms for girls are presented with respect to the following objective indices: age of walking, three stages of pubic hair growth, three stages of breast development, age at maximum growth, age at menarche, three stages of skeletal growth, every fifth per cent of mature height from 45 to 99 per cent, inclusive. The findings show that breast development of girls begins on the average at 10.6 years and reaches the adult stage on the average at 13.9 years. The average age at which pigmented pubic hair first appears in girls is 11.6 years; while the age at reaching the adult stage of pubic hair development was not reliably determined (average r between three judges was .61), but it was later than 13.2 years. The average age at menarche for this Berkeley sample is 12.8 years.

For boys, the norms cover the age of walking, four stages of primary and secondary sexual characteristics, age at maximum growth, three stages of skeletal development, every fifth per cent of mature height from 45 to 99 per cent, inclusive. The average age of the boys when the first signs of sexual changes appeared is 11.8 years and the average age of reaching the mature stage is 15.2 years. The average age of maximum growth for boys is 13.8 years as compared with an average age of 11.5 for girls.

3. To determine the degree of generality in adolescent growth, a factorial analysis (using Spearman's method) of the intercorrelations of these indices (excluding age of walking) was made. This analysis yields a general factor with high loadings in each index. With the exception of one index for boys (Skeletal Age 11.25), the factor accounts for well over half of the variance of each index, thus showing the high degree of relationship between measures as phenomenally different as pubic hair development and closure of certain epiphyses.

4. For both sexes, it appears that the age at reaching 90 Per Cent of Mature Height is the best single measure of physiological maturity. For girls, the least adequate is Skeletal Age 16.25; for boys, Skeletal Age 11.25. The results indicate that when longitudinal data collected over a fairly wide temporal span are not available and the use of Per Cent of Mature Height indices thereby ruled out, measures of sexual or skeletal stages are satisfactory substitutes.

5. With the exception of the variable 90 Per Cent of Mature Height for boys, the combining of several indices in multiple regression equations results in better estimates of factor scores for each child, the multiple correlation coefficients ranging from .90 through .99.

6. A Maturity Score in standard score form which measured over-all adolescent physiological maturation is derived for each individual. This score (spreading over 4.5 standard deviations) represents the best possible estimate, for the indices used, of the standing of an individual relative to others in regard to the chronology of maturation. Covering a wide range of maturity scores, it offers statistical advantages not available in dichotomous early-late categories.

References

1. Bayley, Nancy. The development of motor abilities during the first three years. *Mongr. Soc. Res. Child Develpm.*, 1935, 1, 1-25.
2. Bayley, Nancy. Skeletal maturing in adolescence as a basis for determining percentage of completed growth. Reprinted from *Child Develpm.*, 1943, 14, 1-46.
3. Bayley, Nancy. Tables for predicting adult height from skeletal age and present height. Reprinted from *J. Pediatrics*, 1946, 28, 1-16.
4. Dennis, W. On the possibility of advancing and retarding the motor development of infants. *Psychol. Rev.*, 1943, 50, 203-217.
5. Greulich, W. W., *et al.* A handbook of methods for the study of adolescent children. *Monogr. Soc. Res. Child Develpm.*, 1938, 3.
6. Greulich, W. W., *et al.* Somatic and endocrine studies of puberal and adolescent boys. *Monogr. Soc. Res. Child Develpm.*, 1942, 7.
7. Jones, Mary Cover, and Bayley, Nancy. Physical maturing among boys as related to behavior. *J. educ. Psychol.*, 1950, 41, 129-148.
8. Macfarlane, Jean Walker. Studies in child guidance: I. Methodology of data collection and organization. *Monogr. Soc. Res. Child Develpm.*, 1938, 3.
9. McNemar, Q. *Psychological statistics.* New York: Chapman and Hall, 1949.
10. Merry, Frieda K., and Merry, R. V. *The first two decades of life.* New York: Harper, 1950.
11. Pyles, Marjorie, Stolz, H. R., and Macfarlane, Jean Walker. The accuracy of mothers' reports on birth and developmental data. *Child Develpm.*, 1935, 6, 165-176.
12. Reynolds, E. L., and Wines, Janet V. Individual differences in physical changes associated with adolescence in girls. Reprinted from *Amer. J. Dis. Child.*, 1948, 75, 1-22.
13. Shuttleworth, F. K. Sexual maturation and the skeletal growth of girls age six to nineteen. *Monogr. Soc. Res. Child Develpm.*, 1938, 3.
14. Shuttleworth, F. K. The physical and mental growth of girls and boys age six to nineteen in relation to age at maximum growth. *Monogr. Soc. Res. Child Develpm.*, 1939, 4.
15. Simmons, Kathryn, and Greulich, W. W. Menarchial age and the height, weight, and skeletal age of girls age 7-17 years. Reprinted from *J. Pediatrics*, 1943, 22 (5), 2-32.
16. Spearman, C. *The abilities of man.* New York: Macmillan, 1927.
17. Stolz, H. R., and Stolz, Lois M. *Somatic development of adolescent boys.* New York: Macmillan, 1951.
18. Thomson, G. S. *The factorial analysis of human ability.* New York: Houghton Mifflin, 1939.

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ADULT DISCOUNT: AN ASPECT OF CHILDREN'S CHANGING TASTE

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I

During the course of a larger research (7) that was designed to explore the adequacy of postulating five factors—content, medium, personality, the immediate setting of contact, and the social definitions of content, medium and medium activity itself—to determine the responses of an audience of children[1] to mass communications, we had occasion to run head-on into trying to account for the fact that as children grow older their tastes for dramatic material change. In the course of trying to explain this, we found in the notion of adult discount an unhappily neglected but happily appropriate means of beginning to grapple with the problem.

In this paper we wish to present some of our data on children's changing tastes and by using the notion of adult discount try to make them intelligible. We will first describe the changes in taste that were observed, along with relevant interview material, then present the concept of adult discount and demonstrate how the children's reactions are made intelligible by its use.

II

By means of interviewing we determined what sorts of drama the children liked best. We found that the largest percentage of kindergarten children preferred westerns and the humorous stories that have animal or puppet characters (cartoons or otherwise). Second grade children tended to prefer westerns; fourth grade children tended to prefer comedy and adventure (stories without the recurrently same locale and without continual recurrence of the same hero); and the sixth grade children tended to prefer comedy, adventure, and horror (or spooky) stories. These findings are in accord with past studies of the taste of children (9; 10; 14, pp. 51-72).

The problem lies in explaining why the children's tastes change as they grow older. The pattern of changing taste is associated most closely with

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[1] The audience of children consisted of 79 lower class public school boys whose ages ranged from $5\frac{1}{2}$ to $13\frac{1}{2}$ years, approximately 20 from each of 4 school grades—kindergarten, second, fourth and sixth.

It is unfortunate that in order to protect the anonymity of the children I cannot name the principal, officials and teachers who made me welcome at the school where I interviewed the children. I can only express my debt and gratitude in this obscure way.

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age; sex, social class, and even British or American nationality do not seem to be so crucial (5, pp. 332-339; 6; 9; 10). This suggests that some factor implied by age and unlimited by the *specific* implications of sex, social class, and British or American nationality is the key to the explanation.

One thinks first of all that emotional needs must be that key factor (8). Many writers have claimed that emotional needs are what is primary in responding to drama, thereby implying that taste would be determined by such needs, and some evidence exists that in some cases taste is closely connected with emotional needs (1, 2). But to our knowledge no investigator has been able to establish reliable statistical associations between emotional needs and taste in the case of either adults or children. We, too, were unable to find such associations (7). It appears that the same drama can be perceived differently by different individuals so that those with different emotional needs can have the same tastes or those with similar emotional needs have different tastes.

In the face of that we turn to the usually overlooked cognitive aspects of child development—the active accumulation of experience and expansion of social intelligence that go with increasing age (13). Perhaps these aspects, rather than the emotional, can be more satisfactorily connected with taste. In order to investigate them we must find out what the child knows about the dramatic material he sees, hears, or reads, and how he uses that material; this involves listening closely to the children's verbalizations about their tastes and probing as long as the results are enlightening. We probed, in fact, not only the children's reasons why they liked what they did, but also why they disliked what they did. This last proved to yield rich material.

The point of departure for criticizing what they have rejected lies in the epithet "babyish." What the older child dislikes, babies like. A sixth grader, for instance, said that he liked cartoons, and friend interrupted with an exhortation not to be a baby. A second grader complained that he only had animal comics—baby comics—to read. The older children apologize for watching something like Captain Video by saying, "I have to watch that—my little brother puts it on."[2] They emphasize their sophistication by pointing the finger of scorn at "the little kids [who] get excited and jump up and down like that" when they see babyish drama. What the older children do not like is liked by younger children. What excites younger children fails to excite them.

The older children do not find the pictures they dislike to be *convincing*. '[The cowboy] comes and everyone falls dead—one shot." One boy asked his friends, "What's that picture we saw where all the guys are missing—all the guys are on top of each other and they're missing each other?" Another said, "They never run outta bullets." Captain Video is "goofy because when they crash no one gets killed—they all walk out." "They never die, they never get killed."

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[2] Unless otherwise noted, all quotations are literal transcriptions from wire recordings made of the interviews. The interviews took place during the first five months of 1951. All children's names are fictitious.

Not only are such rejected dramas unconvincing because they are frequently implausible, but because they are cut out of a pattern that has become obvious and all too *predictable*. A longer interview passage will give us a clear picture of this in conjunction with other objections.

WILLIAM: Well, what I don't care about—I don't like cowboy pictures so much.

INTERVIEWER: Why not?

WILLIAM: You see the guys running for the crook, they jump on the crook, and you always see them rolling down the hill.

NORTON: Yeah.

WILLIAM: Never flat.

NORTON: They never fell flat.

WILLIAM: They jump off the horse like they're made of steel and pom, they land on the [crook].

NORTON: Or else the horse is standing over there and the guy's about on a two-story building so he—the guy jumps off right onto the horse and he's riding away.

CHARLIE: Yeah.

INTERVIEWER: I'd hate to be the horse.

CHARLIE: Yeah.

NORTON: Or like one guy rides into the town and about fifteen other guys are waiting for him. He rides right through the town—bang, bangbang, bang, bang, bangbangbang, and he's riding outta the town. Every other guy is dead (*he laughs*).

CHARLIE: Yeah, and they never ran outta bullets, either.

NORTON: No.

WILLIAM: Bough, bough, bough, bough. (*imitating gun shots*)

NORTON: The six-shooter. For a sixshooter they sure carry lots of ammunition.

CHARLIE: Fifteen, sixteen, bough, bough, seventeen (*laughs*) and they're still shooting. Then one time the guy shot two bullets—outta the gun . . it was empty. Then he pulls out another one and keeps shooting the thing. About ah, there was about ten guys and along they came and the guy shoots out his gun, takes out his other one, and bababababa, everybody's dead . . . .

NORTON: I mean, like, that's impossible, if a man is supposed to fight against so many others and he comes out alive all the time. . . .

CHARLIE: But in a cowboy picture, in a cowboy picture, there they go. The picture starts—wham, one guy goes, about fifteen other guys. Here comes the posse, bang, bang, bang, they're all dead. They go into town. There's an ambush ready for them. Bang, bang, bang, they're all dead too. He goes into the next town, sneaks in. One guy notices him. There, he gets caught. All right, that's all. Bang, bang, bang, they get him outta jail. Bang, bang, bang, they're all dead again. That's all that goes through the picture, just horses and shooting.

INTERVIEWER: Well, it's a story isn't it, I mean—

NORTON: It's exciting and all that, but it gets boring. . . . Nowadays, pictures aren't—I think they're fading away.

III

By calling what they do not like "babyish," the older children are stating the fact that what they do not like is liked by younger children and expressing an attitude of derision all at once. It is only when we go beyond the merely general and pejorative term that we begin to get at the basis for the children's taste. We have seen that they reject particular types of stories because (*a*) while they might be exciting to "babies," they are not exciting to older children, (*b*) the stories are implausible and unconvincing because they are unrealistic, and (*c*) the stories are boring because they are too easily predictable. Much might be made out of this *ad hoc,* but we are fortunate in having two independent researches through which we may clarify the problem, and the concept of adult discount in terms of which we may order the material. Before going deeper into our material, then, we turn to those previous researches and the notion of adult discount.

In their study of the emotional responses of children to moving pictures, Dysinger and Ruckmick (4) found that as the age of their subjects increased, their psychogalvanic and pneumocardiographic responses to movies tended to decrease. In other words, the older the child, the less was he actually excited by the movies. The condition of not being as excited as young children was termed "adult discount." The connotations of the term are such as to fill in the rest of the definition.

This "adult discount" appears to be connected first of all with the ability to predict what will happen next in a story. Dysinger and Ruckmick noted that upon repeated exposure to the *same* movie, their subjects' responses decreased markedly, no matter what the age. This implies that the subjects had learned what would happen next during the repeated showings and consequently did not respond so intensely. The authors in fact noted that where the anticipation of a fearful event is *predictive* in nature, the intensity of emotional response decreases. In order to arrive at "adult discount," then, children must learn to be able, in some sense, to anticipate what will happen next in a drama.

Using similar methods of recording circulatory, respiratory, and electrodermal changes, plus direct observation, DeBoer (3) studied the emotional responses of children to radio drama. He found, like Dysinger and Ruckmick, that younger children responded more frequently than older children. He noted that the younger children seemed to react to each separate incident of the story rather than to exhibit any steady rise or fall of interest over any large section of the plot; they reacted in a succession of shock-like responses. Adolescent children, on the other hand, exhibited in addition to responses to individual incidents a clear sense of the continuity of the story, for they demonstrated a steady rise of responses over the later phases of the plot as a whole. "This consciousness of the larger plot patterns was reflected also in the vigorous response noted in the case of surprise endings, which presupposes a powerful interest in the relationships which gave the surprise endings significance" (3, p. 109).

We may venture to conclude from this that part of the growing ability to predict seems to lie in the growth of the child's command over the total plot of the drama, for without a sense of something more than discrete incidents, prediction is impossible. Part of the growth of this command seems to lie in repeated experience with the same type of drama as well as repeated experience with the same drama.

There is another aspect, however, that also seems tied in with the strong responses of young children and the weak responses of older children. DeBoer noticed that younger children seemed to react to dramatic events as if they were real, while the "older children, particularly those in the age group from 12 to 14, tend to objectify the narrative to which they are listening and to regard it as entertainment rather than a series of incidents directly affecting themselves" (3, p. 106). The older children seem more *detached* from the dramatic experience than the younger.

This detached attitude toward drama has been dealt with by estheticians under such terms as "psychical distance," and "detachment." John Hospers (11), for example, considers it to be the minimum attribute of the esthetic attitude. "This fundamental attitude consists in the separation of the esthetic experience from the needs and desires of everyday life and from the responses which we customarily make to our environment as practical human beings. . . . The esthetic attitude can occur only when [the] practical response to our environment is held in suspension" (11, p. 4). We may venture to point out that separating experience with drama from experience in daily life involves making distinctions about *reality*. In order to be detached from experience with drama, one must not consider it to be as real as, or the same kind of reality as, that of practical, everyday experience.

We may say, then, that in order to be said to "possess" adult discount, an individual must develop at least (*a*) the ability to view a plot as a unified whole so that prediction or anticipation is possible, and (*b*) a distinction between the reality of practical experience and the reality of experience with drama such that a modicum of detachment from dramatic experience is possible. Adult discount involves a certain tempering of response to drama, a certain suspension of complete involvement.

IV

The older children have claimed that their tastes have changed because what once excited them and what still excites younger children is no longer sufficiently exciting to be pleasurable. In this sense, change of taste involves decrease in emotional response to a particular type of experience. The reasons they give for this suggest that this decrease in pleasurable excitement is caused by their developing ability to predict too easily what will happen next in the "babyish" stories, and by their feeling that the action in those stories is too unrealistic to be plausible. In our analysis of adult discount, we suggested that the ability to predict presupposes an ability to treat of a plot as a coherent whole. We may note now that questions of the plausibility of a story can arise only when one has become sufficiently detached from experiencing the story to stand outside it and judge it *as* a story. As we have already suggested, this detachment in turn presupposes a distinction between dramatic experience and practical experience, dramatic and "real" reality. If this is correct, we should expect to find paralleling change in taste a development of the children's conception of plot and a concomitant development of the distinction between dramatic reality and experiential reality. Such a development was, in fact, observed, and will be described in the following pages.

From the second grade on, we find the children continually using the term "action" in conjunction with media drama. A story is good if it has action and bad if it has none. Whether the story has action or not is one of the basic critical criteria of excellence. But we find that action means different things for each of the age-groups. To trace the changing meaning of that term is, in fact, to trace the development of their ability to encompass a plot as a unified whole.

For the younger children the total plot is weighed only to the extent that it contains incidents that actually elicit emotional response. "Action" consists in such incidents. If there is only one exciting incident in a plot, that incident is all that represents the experience of the whole plot. In this sense, the younger children seem to be impressed more by isolated actions within the plot than by the plot as a whole.

> Hey, did you see that Gene Autry, when they was riding along and one says to the other, "This looks like a nice peaceful place, let's camp here," and he was going to get some water when whizz, an arrow went right through his hat!

These events stand out because they elicit excitement from the children. Since the intervening events do not elicit excitement, they seem to be just about lost to the children. Hence the children's view of the plot as a whole is vague and impressionistic, at its most coherent a patchwork of discrete events that are exciting.

> Hey, did you see that one with the leopard, when he jumped on him and killed him?

The story is experienced as a number of isolated instances of excitement not necessarily joined into any whole. A story is full of action if it has a large number of such instances.

In the fourth grade the children are looking for new twists, new kinds of chases, new types of dangers. They begin to look for more complicated combinations of events that meaningfully encompass the plot rather than discrete events that exist as sharply defined parts of a vague whole. The whole plot becomes one great event in which temporal sustention can itself become a value.

> I like Charlie Chan because he's the hardest one to solve mysteries—it takes about three weeks to solve them.

It is in the fourth grade that we first find spontaneous mention of the type of drama we call funny-spooky—deliberately sustained blendings of the broadly comic and the terrifying like Abbott and Costello Meet Frankenstein. Comic relief is present in more "babyish" cowboy stories of course—some of the younger children in fact are attracted to a cowboy series not because of the hero but because of the comic foil who always accompanies him—but in the fourth grade the conception of plot as a totality has become so clear that instead of liking something for its isolated funny or exciting episodes, the various episodes are contrasted to each other as part of a whole. Consequently, these older children are able to talk about "putting comedy in the murder pictures," about a total plot in which horror is purged by laughter.

In the sixth grade we find a still greater emphasis on the plot as a whole. As we might expect, more of the children make spontaneously appreciative reference to the funny-spooky type. They seem to be more conscious of a story as a sustained whole, not only as a sustained whole lasting over a certain period of dramatic and natural time, but as a structural unity as well. They have become sophisticated enough to be able to predict what will happen in the highly stylized cowboy stories and seem to be extending this sophistication into other fields. One boy said he preferred watching television with his father because his father tells him "more about them—what's gonna happen next." After some debate the others agreed that sometimes they would like to know what will happen next. This matter of prediction becomes important.

This matter of prediction puts the children in a peculiar quandary. On the one hand we take it to be axiomatic that what they seek in their drama are thrills—catharsis, purgation, what you will. But on the other hand, whether by virtue of their expanding intelligence and growing control over their experience or their cultural milieu or something else, they also place a premium on being able to predict or anticipate the events of a story. Their ability to predict, however, decreases the thrills they can obtain and disqualifies more and more types of drama from being thrilling. Where younger, less sophisticated children still find infinite diversion in media drama, the older children complain of being "tired of too much of the same thing."

Sky King is decried as "kids' stuff. You can guess right away. Like in that movie The Creeper you couldn't tell who it was." Sophistication grows, more action can be predicted and presumably less action is moving. So the children tend to seek stories that are difficult to predict, or else stories that are so terrifying that predictive ability is petrified. One sixth grader said, "Spooky things, they got thrills in them. Mystery things, you just watch and see guys getting killed." The dangers of mere killing become monotonous and mechanical so that new thrills are sought in the extraordinary dangers of the supernatural or superhuman.

> One Million B.C. and, ah, Adventure Island, there was two good pictures about animals of long ago. . . . They're more exciting, because if you saw a big twenty-foot animal coming over you with big fangs over you you'd get more afraid than if a man came at you with a gun. You could protect yourself, but you shoot that thing, it'd just bounce off.

Such stories are liked because it is difficult to predict how one would overcome the danger.

We may conclude this discussion of "action" by presenting the most refined distinctions made in the sixth grade. In them is a shrewd grasp of plot and a keen conception of what makes a plot effective.

> INTERVIEWER: What's action in a picture?
>
> CHARLIE: Well, in a picture action is something fast. One person—before you know it he does what you least expected. Like in that Red River, it was exciting because it was all the way across the West, it was all tension until the end of the picture and then came the action and there was plenty of it—there's shooting, everybody was fighting each other.

Action is crude and physical, but there is an implicit critical criterion of action that places it in the context of a larger whole. The spectator is excited because everything *as a whole* moves quickly, tensely, expectantly, unpredictably towards the final explosion of energy. Action is no longer in the isolated event, but rather in the event's relationship to the whole. The same boy characterized the action in spooky pictures.

> During the spooky pictures there isn't much action. It's all slow like that —that's what gets you scared.

Action as physical action is almost lacking in the spooky. Here it is the attenuated pacing of the plot as a whole, dominated by the indefinable sense of threat that fascinates, terrifies, and pleases; the single exciting events are no longer necessary for excitement and pleasure.

V

There is one other term that the children use in discussing drama—"phony" or sometimes "fake" and "corny." They use those terms to indicate that the drama is contrived and implausible. When they use such a criterion for their criticism, they are assuming, first, that drama imitates or represents some reality and, second, they are assuming particular conceptions of what is or what can be real. Ghosts are real, but a six-gun that shoots twelve times is phony. They are distinguishing between "real' reality and drama and judging drama by the extent to which it is true to "real" reality. We wish to point out here how that distinction between dramatic and experiential reality (and the attendant detachment from dramatic experience) develops over the grades, and how it is manifested in the children's reactions.

We have little material from the kindergarten children, primarily because they do not seem to use any criterion of reality in their discussions of mass media drama. Description of a story merges into private fantasy to such an extent that it is quite difficult to tell where the one ends and the other begins. And they have a tendency to act out the events as if they were actually experiencing them.

In the second grade we find most of the children accepting the stories if not as true events that directly affect them, then certainly not as "just" stories. One boy implied that Cactus Jim was "only" an actor by pointing out that his beard is false, and another was offended by the implication and willing to bet that the beard and Cactus Jim are real. The children seem mostly to be impressed by the likely impossibility (to use Aristotle's term) that the events they experience in drama are real, and their reactions are more intense, more proportionate to something that directly affects themselves than those of older children.

BARRY: I saw that picture about Flash Gordon. There was a gorilla that broke a nigger's neck.

ERNEST: It's just a picture. There's a man inside.

BARRY: But sometimes there might be a gorilla inside.

Though they might already be beginning to be aware of the convention of drama in merely *representing* reality, the stories seem real enough for them to feel that they might be real anyway. The "real" reality of the story is a likely impossibility.

By the fourth grade the children have made the distinction between dramatic reality and real-life reality and begin to judge the excellence and plausibility of a story by its faithfulness to what they consider the real to be.

TIM: Like Captain Video, what a phoney.

MARK: Yeah, it's only a film.

TIM: No, it's a play.

MARK: Yeah, but you don't really see them going up to the moon, now, do you?

In the sixth grade there is merely a heightening of the same sense of critical detachment—drama is not "real" anymore, but since it is supposed to represent reality, it is judged in terms of its faithfulness.

LEO: Did you see [that picture about Cortez]? An arrow went through his head so they put a hot iron on it and pulled it out. And then he was shot in the heart and he still wasn't dead.

BOB: Yeah, they never die, they never get killed.

Enough of this kind of jaundiced, literalistic, and bloodthirsty criticism has already been presented to preclude the necessity of more.

VI

The notion of adult discount suggests why older children are no longer moved by what excites younger children. The ability to encompass a plot as a unified whole has developed so that they become able to predict what will happen next (which lowers emotional response); the realization that drama is not the same as experiential reality has developed so that the older children become more detached from their experience with drama (and this too tempers emotional response).

We may point out that among the children of this research the process of changing taste is more or less *independent* of specific adult influences. Cowboy dramas, for example, are eventually rejected whether parents make an active effort to encourage rejection or not. On the contrary, the main outlines of the process appear to involve the dynamic combination of social interaction with peers, accumulation of experience with drama, and the developing intelligence of the child himself. In this paper we have dealt only with the *products* of that combination—the child's developing sense of plot and detachment from dramatic reality—and have reserved for another paper the process by which the product emerges.

It may be suggested that the gamut of taste we have observed, from the most highly stylized and "unrealistic" cartoons and cowboy series to the more varied and more "realistic" adventure dramas, can be partially understood by reference to the content of the dramatic material itself. Cartoons and cowboy stories, with their ritualistic plots and fixed constellations of characters who have constant traits and behave always in the same way, seem to be among the types over which it is most easy to gain command, the types which are most attractive to the naive, inexperienced audience whether child or adult. The relatively unsocialized child would tend naturally to be attracted to such types rather than to others. Given our cultural milieu that emphasizes "realism" and through the peer group encourages the active questioning and skepticism typical of urbanism, given extensive experience with these types of content, the growth and active use of social intelligence tends to make for shifts in taste toward the "realistic," "authenticated," culturally-prized type of drama in which characters are more varied and have more or less human traits, and in which dramatic action is more complex and less highly ritualized. In keeping with the development of the child, it is a movement from the simple to the more complex as well as a movement from the childish to the more fully socialized. In another cultural milieu with different socialized standards (12), we should still find that *form* of movement, though the substance may be different.

Finally, we wish to emphasize the suggestion that the emotional gratification that may be obtained from dramatic material is limited by the detached, critical attitude that adult discount involves. A sophisticated sixth grader, no matter what his emotional needs, will not be able to obtain the same degree of emotional stimulation from a typical cowboy story as a kindergarten child. In the same sense, adult discount seems to place definite stricture on the extent to which the spectator is able to use dramatic material as fantasy—to the extent that he adopts a critical and detached attitude in attending to drama, to that extent the spectator is not sufficiently involved in the drama to be able to use it as an emotionally charged fantasy and thereby obtain emotional release. Indeed, whenever we speculate about or investigate the effects or even the character of mass media experience, if we seek accuracy, these considerations must be taken into account.

REFERENCES

1. BENDER, LAURETTA. The psychology of children's reading and the comics. *J. educ. Sociol.*, 1944, 18, 223-231.
2. BUXBAUM, EDITH. The role of detective stories in a child analysis. *Psychoan. Quart.*, 1941, 10, 373-381.
3. DEBOER, J. J. The emotional responses of children to radio drama. Unpublished Ph.D. dissertation, Dept. Educ., Univ. Chicago, 1938.
4. DYSINGER, W., and RUCKMICK, C. A. *The emotional responses of children to the motion picture situation.* New York: Macmillan, 1933.
5. Edinburgh Cinema Enquiry. Described in M. Adler, *Art and Prudence.* New York: Longmans, Green, 1937.
6. FORD, R. *Children in the cinema.* London: G. Allen & Unwin, 1939.
7. FREIDSON, E. An audience and its taste. Unpublished Ph.D. dissertation, Dept. Sociology, Univ. Chicago, 1952.
8. FRIEDLANDER, KATE. Children's books and their function in latency and prepuberty. *Amer. Imago,* 1942, 3, 129-150.
9. HANDEL, L. *Hollywood looks at its audience.* Urbana: Univ. Illinois Press, 1950.
10. HERZOG, HERTA. Survey of research on children's radio listening. (mimeographed) Office of Radio Research, Columbia Univ., 1941.
11. HOSPERS, J. *Meaning and truth in the arts.* Chapel Hill: Univ. North Carolina Press, 1946.
12. OVERBEEK, *W. H.* Massapsychologische onderzoekingen in een volkstheater. *Mensch en Maatsch,* 1939, 15, 1-21. Abstracted in *Psychol. Abstr.,* 1939, 13, 265-266.
13. PIAGET, J. *The psychology of intelligence.* London: Rutledge & Kegan Paul, 1950.
14. WOLF, K. M., and FISKE, M. The children talk about comics. In P. Lazarsfeld and F. Stanton, *Communications research, 1948-1949.* New York: Harper, 1949.

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CHILD ANIMISM: WHAT THE CHILD MEANS BY "ALIVE"[1]

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INTRODUCTION

Piaget has been concerned with the nature and development of the child's thinking, of his conceptions of the world, and the reasons for qualitative differences at various ages. Among other characteristics of child thought, Piaget studied animism (5). By animism he means the attributing of life and consciousness to certain inanimate objects, but he qualified this meaning in various ways which seem not to be entirely consistent. These two aspects of animsim, "consciousness attributed to things," and "the concept of 'life'," are treated separately by Piaget. Whether or not a child attributes consciousness to an object is determined by asking him if the object can feel or is aware of various sorts of stimulation or activity, and why the child thinks so. Regarding the concept of life, the child is asked: "Is the ——— alive?" and "Why?" In each case the child is assigned to one of four stages of animism. The criteria for categorization are similar in each case, and essentially as follows:

The child who attributes consciousness and life to anything that is in any way active, undamaged, or useful is assigned to *Stage 1* for both consciousness and life. A whole dish is alive; a broken dish is not alive. The child in *Stage 2,* for both series, attributes consciousness and life to anything that moves. A ball is alive when it is rolling; otherwise it is not alive. For a child in *Stage 3* anything that moves of its own accord is conscious and alive. The sun and moon are alive; a bicycle is not alive, even when moving. The child in *Stage 4* restricts consciousness and life to animals alone, or to plants and animals. Humans and animals are alive, and many children in this stage state that plants are alive.

Piaget states: ". . . children who are in the first or second stage when speaking of consciousness are generally found to be in a more advanced stage for ideas concerning life. The elder children, on the contrary, that is to say, those in the third and fourth stages, are usually in the same stage in the

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parallel series" (5, p. 205). Regarding children in the second stage of animism, Piaget states:

> The impression these children give is that the assimilation of life to movement is evidently simply a matter of words. That is to say, the word "life" means simply movement, but this movement has none of the characteristics with which we should define life, such as spontaneity, purpose, etc. . . .
>
> We think, however, the matter goes deeper, and that movement in general is really thought to possess the characteristics of life (5, pp. 200, 201).

Piaget does not make clear, however, what he means by "the characteristics of life."

More recently, investigators have employed questions aimed at determining the types of objects the child regards as alive as a measure of animism. They have disregarded questions related to consciousness, or have employed them as a measure of the child's usage of the term *alive*.

In a very well controlled investigation, Russell and Dennis (8) developed a standardized procedure for the study of child animism. Regarding a list of 20 objects, six of which were arranged on a table, each child was asked: "Is the ——— living or dead?" and "Why?" On the basis of his answers, each child was assigned to one of Piaget's four stages of animism, or to a "No Concept Stage" when ". . . the child was responding in the absence of any definite concept of the animate and the inanimate."

Russell (6) was also interested in establishing quantitatively the developmental course of child animism. In addition he investigated such factors as socio-economic status, sex, geographic location (urban, suburban, or rural residence), grade status, mental age, and chronological age. It was concluded that: "The stages of animism are equally related to both mental age and chronological age, the Coefficients of Mean Square Contingency for the combined groups being 0.59 and 0.62 respectively." No significant relationships were found between stage of animism and geographical location, socio-economic status, or sex of the subjects.

Russell (7) has also investigated what he termed "allied concepts," and their correlation with stage of animism. By allied concepts Russell means, ". . . ideas which are 'allied' in adult thought to those of animation, such as 'knowing' and 'feeling'." He continues, "The problem may be stated specifically as follows: Is the development of animism by characteristic stages merely a function of the child's usage of the terms 'living' and 'dead' or is the development due to more inclusive ideas concerning the nature of 'life' in general." Following the questions regarding "animism," one-half of 335 subjects were queried as follows: "Does the ——— know where it is? Why?" The other half were asked: "Does the ——— feel when I touch it?" (or a more plausible variation for remote objects) and "Why?" Upon the basis of these answers each subject was classified, ". . . on the same basis as the classification of animistic responses." Russell found a 63 per cent correspondence between the stages of animism and the stages of allied concepts. On the basis of this evidence, he drew the following conclusions:

> These facts answer the question raised in the introduction of this paper as to whether or not the development of animism is merely a function of the subject's usage of the terms "living" and "dead." Since in the majority of cases the subject attributes "knowing" and "feeling" to those objects that he considers "living," and since the development of the two series of concepts follows the same progression of stages, the author feels justified in the use of the term "animism" as descriptive of the subject's ideas of "life."

Russell states: "Each subject was questioned individually, the questions involved in the present work being asked immediately following an examination for stages of animism." However, it is not clear whether questions about "knowing" or "feeling" were asked in a separate series after questions regarding "life" ("animism") had been completed for *all* objects, or whether they were asked regarding each object immediately after questions regarding "animism." If the latter was the case, it may be that a child who said that an object was "alive" would also tend to say that it could "know" or "feel" in order to be consistent.

Several investigators (1, 2, 3, 4) have made some attempt to refute experimentally Piaget's claim that when a child—at least a child in *Stage 2*—states that an inanimate object is "alive," he also attributes certain "characteristics of life" to that object, but it is felt that additional clarification is desirable.

Russell's study (7) dealing with "allied concepts" tends to support Piaget's view, but it is felt that a wider sampling of "allied" questions should be employed.

The present study is an attempt to determine what the child means when he states that an object is alive. Stated differently, when a child states that an *inanimate* object is alive, does he necessarily assign to that object certain sensory and functional attributes which the adult usually assigns to *animate* objects, particularly animals?

Piaget states that the study of the concept of "life" shows, ". . . the ideas children understand by the word 'life' " (5, p. 194). It is true that the child's answers to the "Why?" questions, that is, "Why do you think ——— is alive?," reveal in part what the child means by the word *alive*. However, it is felt that motion, or activity, is the reason most often cited by the child as the differentiating criterion between the "animate" and the "inanimate," because motion is the most prominent differentiating quality, and one which is relatively easy to express. Another approach to the child's concept of *alive* is to ask him several supplementary (allied) questions regarding sensory and functional attributes, such as feeling, breathing, thinking, etc.

SUBJECTS

The subjects were obtained from the grade and junior high schools of Springdale, Pennsylvania (population approximately 5,000). Although IQ scores were not obtained, school officials stated that records indicate that the groups have mean IQs near or slightly above 100. Thirty subjects were selected from each of the following grades: kindergarten, first, third, fifth, and seventh (see Table 1). In order to screen out children who were either too young or too old for a particular grade, age limits were arbitrarily established for each group (see Table 1). Eleven students were eliminated by this screening.

TABLE 1

DESCRIPTIVE DATA REGARDING SUBJECTS

Grade	*N*	*Mean Age* Yrs. Mos.	*Males*	*Females*	*Arbitrary Age Limits*
K	23*	5 – 10	9	14	5–0 to 5–11
1	30	6 – 9	13	17	6–0 to 7–11
3	29*	8 – 11	15	14	8–0 to 9–11
5	30	10 – 11	17	13	10–0 to 11–11
7	30	12 – 10	15	15	12–0 to 13–11
TOTALS ...	142		69	73	

* Seven kindergarten records and one third grade record were deleted because of perseveration (see Results).

The other criterion for elimination was whether a child had a sibling in one of the other grades to be tested. This was done to reduce the possibility of discussion of the test at home and instruction by parents of subjects who had not been tested. Thirty-eight students were eliminated on this basis. One child in the kindergarten group was eliminated because of serious nystagmus and questionable mental capacity. The subjects were selected from alphabetical lists of the remaining students.

PROCEDURE

Materials. Six inanimate objects: a burnt kitchen match, a broken dish, a pocket knife with one blade open, a comb, an alarm clock which ticked loudly, and a lighted candle; and two animate objects: a goldfish in a glass bowl, and a flower (blooming petunia in a flower pot) were assembled on a table. It is felt that these objects represented a sample with which most children are familiar, and that the objects vary greatly as to real and/or apparent animation and functional value. In addition to extending the continuum to include objects which are really alive, the fish and the flower were included as control objects for two reasons: (*a*) as a basis for comparing the responses to inanimate objects, and (*b*) in order to reduce the likelihood of, and as a measure of, perseveration. With animate objects included, some correct responses are "No" while others are "Yes."

Questions. The following ten questions were asked regarding each object: 1. Is ——alive? 2. Would —— feel pain if I stick a pin in it? 3. Does a —— grow? 4. Can —— hear us talking? 5. Does —— breathe? 6. Does —— think? 7. Can —— see? 8. When —— moves, does it know that it moves? 9. Can —— make a wish? 10. Is —— alive? Question 1 was repeated as question 10 to obtain a measure of the degree to which the child's usage of the term *alive* might change as a result of the intervening allied questions. It is felt that questions 2 through 9 (hereafter to be termed allied questions—following Russell) represent a sample of possible questions concerning sensory and functional attributes of higher forms of life, particularly man. The child's responses to these questions provide a basis for making inferences regarding (*a*) his concepts of these objects, and (*b*) what he means by the term *alive.*

No "Why?" questions were asked until all ten questions had been asked of all objects. It is felt that if a child is asked to give his reason for thinking a particular object is alive or not alive, he may employ his stated reason—which can be only a small part of his total concept—as a criterion for judging questions regarding other objects. "Why?" questions were asked in some cases after the formal questioning had been completed, particularly when the child stated that the clock or the candle was alive.

Each subject was questioned individually while seated opposite the experimenter; the objects were assembled on a table between them in random order (in terms of real and/or apparent animation). After a brief preliminary introduction to the situation, including for the younger children remarks to the effect that this was a "kind of game," each child was given the following instructions: "I am going to ask you some questions about the things you see on the table. Some will be easy and some not so easy. If you don't know the answer, just say, 'I don't know'."

The subject was asked: "Is the knife alive? Is the fish alive? Is the match alive?" etc., through the list of eight objects. When necessary, especially at the beginning of the questioning, the experimenter directed the subject's attention to the appropriate object by pointing. Responses were recorded on mimeographed answer sheets. Then the second question, "Would the —— feel pain if I stuck a pin in it?" was asked regarding each object, then the third question, and so on. This procedure was employed in order to reduce perseveration. Although this does not eliminate the possibility of perseveration, it would have been much more likely to occur had all questions been asked regarding a given object, then another, etc.

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The experiment was conducted during the latter half of May, thus during the latter part of the school term. The subjects were taken from regularly scheduled classes, and therefore had little opportunity to discuss the experiment until after all of their group had been tested.

RESULTS

Deletion of cases. Seven cases in the kindergarten group (grade K) and one in grade 3 were deleted because of perseveration. In the judgment of the experimenter, the recorded responses, in addition to observations made during the testing, indicate that these eight subjects were responding with minimal reference to the stimuli (questions). Either because they did not comprehend the questions, or because of emotional stress—or a combination of these factors—the subjects resorted to answering nearly all questions either positively or negatively at some point during the testing. In each of two cases in grade K, for example, all responses were positive but one. Other records show either some evidence of attempted discrimination followed by stereotyped responses, or alternate series of positive and negative responses followed by stereotyped responses.

With reference to the original data (150 cases), seven cases of perseveration in grade K accounted for 68 per cent of the positive allied responses for that grade, while one case of perseveration accounted for 49 per cent of the positive allied responses in grade 3. Therefore, the records of these eight cases were deleted. All tabulations and computations throughout this paper are based on the remaining 142 cases. When grade comparisons are made, the data are prorated and appropriate notations made.

TABLE 2

TOTAL NUMBER OF POSITIVE RESPONSES FOR FIVE GRADES*

QUESTIONS: *Objects*	1 *alive*	2 *feel*	3 *grow*	4 *hear*	5 *breathe*	6 *think*	7 *see*	8 *know*	9 *wish*	10 *alive*
Match	8	5	3	1	2	1	1	6	2	4
Dish	10	7	1	2	1	1	1	5	0	4
Knife	18	14	1	2	0	3	2	7	2	5
Comb	21	5	1	2	1	0	1	5	3	4
Clock	66	12	3	5	1	4	4	14	3	34
Candle	77	11	7	1	19	1	2	8	9	43
TOTALS	200	54	16	13	24	10	11	45	19	94
Flower	110	45	135	3	34	8	4	20	5	95
Fish	142	133	122	49	131	99	134	131	55	142

* Eight cases of perseveration deleted but remaining data *not* prorated.

Table 2 presents the combined data for five grades. It will be noted that the child's concept of a fish is quite different from his concept of inanimate objects.

Comparison of responses to question 1 and to allied questions. Table 3 shows a comparison of the mean number of positive responses per grade to question 1 for four objects (match, dish, knife, and comb), and the mean number of positive responses per grade for two objects (clock and candle); and the respective *means* for four objects and two objects of the *mean* number of positive responses to the allied questions. The figures in the allied columns are the means for combined objects of the mean number of positive responses to eight allied questions. Thus, for each object the mean number of positive responses to eight allied questions was taken as a measure of the degree of "animism" implied by the word *alive.*

TABLE 3

MEAN NUMBER OF POSITIVE RESPONSES* TO QUESTION 1 FOR COMBINED OBJECTS; AND THE CORRESPONDINGS MEANS OF THE MEAN NUMBER OF POSITIVE ALLIED RESPONSES

	Question 1		Mean Allied	
Grade	*Match, Dish, Knife, Comb*	*Clock, Candle*	*Match, Dish Knife, Comb*	*Clock, Candle*
K	9.1	15.6	2.8	3.5
1	3.8	7.5	.3	1.0
3	1.6	18.1	.2	1.0
5	1.5	23.0	.1	1.0
7	0.5	11.5	0.0	.8
TOTALS ...	16.5	75.7	3.4	7.3

* Prorated.

The rationale for combining clock and candle as opposed to the other four objects is that the clock and the candle evinced activity. The clock ticked loudly and the hands moved; the candle was burning.

For four objects combined, those evincing no activity, there is a progressive decrease in the mean number of positive responses to question 1 and to allied questions from grade K through grade 7, indicating that as the assignment of allied attributes decreases, there is a corresponding decrease in the frequency of positive *alive* responses.

But the patterns for clock and candle combined, objects which evince activity, do *not* follow this trend. Compared with grade 1, there is an increase in the number of positive responses to question 1 for clock and candle combined of over 100 per cent at grade 3, and over 200 per cent at grade 5. There is not a corresponding increase in the number of positive responses to the allied questions. The data indicate that, although children do assign more allied attributes to clock and candle than to the other four objects, the discrepancy is not proportional to the discrepancy in the relative proportions of positive *alive* responses.

On the average there were 359 per cent more positive *alive* responses (to question 1) for clock and candle than for the other inanimate objects; whereas, there were only 115 per cent more positive *allied* responses for clock and candle than for the other four objects (see Totals, Table 3).

Compared with a total of 200 positive responses (not prorated) to question 1 for all groups (see Table 2), there were only 54 positive responses to question 2 (feeling), and 45 to question 8 (knowing), and many fewer positive responses to the other allied questions. These figures vary considerably from Russell's (7) which indicate that, ". . . in the majority of cases the subject attributes 'knowing' and 'feeling' to those objects that he considers 'living,' . . ."

Although 25 subjects in grade 5 stated that the candle was alive, only one stated that it can feel pain, one stated that it grows, none that it can see, two that it knows when it moves, and one that it can make a wish. When asked why the clock was alive, the subject usually answered: "It ticks," or occasionally, "The hands move," or "It tells time."

The child does not regard these objects as being human-like, with many of the sensory and functional attributes of human beings. The fact that an inanimate object evinces some activity or function is sufficient basis for the child to say that the object is alive, by which he apparently means that it is *lively*—evinces activity. It seems to be a matter of limited vocabulary rather than a gross misinterpretation of reality.

Comparison of responses to question 10 and to allied questions. Responses to question 10 are in a sense corrected responses to question 1 after the subject experiences the intervening allied questions. Regarding the inanimate objects, there was a 54 per cent reduction in the total number of positive responses (prorated)—217.0 for question 1, 100.3 for question 10.

Table 4 shows a comparison of the mean number of positive responses per grade to question 10 for four objects (match, dish, knife, and comb), and the mean number of positive responses per grade for two objects (clock and candle); and the respective *means* for four objects and two objects of the *mean* number of positive allied responses. As in Table 3, the figures in the allied columns are the means for combined objects of the mean number of positive responses to eight allied questions. For four objects combined, there is a progressive decrease in the mean number of positive responses to question 10 from grade K through grade 5; there were no positive responses at grade 5, and only one positive response at grade 7 for these objects. Com-

TABLE 4

MEAN NUMBER OF POSITIVE RESPONSES* TO QUESTION 10 FOR COMBINED OBJECTS; AND THE CORRESPONDING MEANS OF THE MEAN NUMBER OF POSITIVE ALLIED RESPONSES

	Question 10		Mean Allied	
Grade	*Match, Dish, Knife, Comb*	*Clock, Candle*	*Match, Dish, Knife, Comb*	*Clock, Candle*
K	2.6	7.2	2.8	3.5
1	1.2	5.5	.3	1.0
3	.8	9.8	.2	1.0
5	0.0	12.5	.1	1.0
7	0.2	5.5	0.0	.8
TOTALS . . .	4.8	40.5	3.4	7.3

* Prorated.

pared with grade 1, there was a mean increase in positive responses to question 10 for clock and candle of 78 per cent at grade 3, and 127 per cent at grade 5. Although these percentage increases are smaller than the relative increases for question 1, there were on the average 743 per cent more positive *alive* responses (to question 10) for clock and candle than for the other inanimate objects, as compared with 115 per cent more positive *allied* responses for clock and candle than for the other four objects (see Totals, Table 4). The discrepancy seems to result primarily from the child's usage of the term *alive* rather than from a misconception of the nature of these objects.

DISCUSSION

It is true that some children do assign certain sensory and functional attributes to inanimate objects, and particularly a kind of elementary sensitivity and awareness (feeling and knowing—questions 2 and 8), but the assignment of sensory and functional attributes is entirely out of proportion to the assignment of the term *alive* to these objects. Although there is some evidence of animism (particularly in the kindergarten group) as indicated by incorrect responses regarding the sensory and functional attributes of inanimate objects, there is little evidence of a gross misinterpretation of the nature of these objects. When the child at grade 3, 5, or 7 states that the clock or candle is alive, he seems to mean primarily that the object is *lively*—evinces activity. This seems to result from the child's misuse of the term *alive* rather than from a misinterpretation of activity *per se*. That is, the child does not conceptually classify these objects in the same category as animals, or animals and plants, but he is unable to make the distinction verbally.

If the adult accepts the child's positive responses to the *alive* questions at face value, with a literal translation from the adult's point of view, he must then postulate an irregular developmental trend in the child's concepts of some objects, and a more or less regular trend for others. That is, one would have to conclude that, compared with children between the ages of 6 and 8 (grade 1), children between the ages of 8 and 14 (grades 3 through 7) have inferior concepts regarding the nature of certain objects (those evincing activity), and at the same time have superior concepts regarding the nature of other objects (those not evincing activity). This would indicate a gross deviation from other mental and physical developmental trends.

It is hypothesized that the reason for the fact that children in grade 1 give fewer positive responses to *alive* questions regarding clock and candle than children in grades 3, 5, and 7 is because the younger children adopt a more elementary frame of reference. That is, more of the younger children divide the objects into animal versus non-animal groupings; whereas, more of the older children visualize a continuum of animation. Conceptually, the older child makes a distinction between objects which evince activity and those which do not, but in so doing misuses the term *alive*.

The data seem to support the views of those who have disagreed with some of Piaget's findings regarding child animism. Contrary to Russell's findings, a majority of the subjects who stated that an inanimate object was alive did not attribute "feeling" and "knowing" to that object. Factors contributing to the discrepancy between Russell's findings and the results of the present study may have been: different sequences of questioning (if in fact there was a difference); the inclusion of "Why?" questions by Russell within the formal testing; differences in the wording of questions; and the employment of more allied questions in the present study.

SUMMARY AND CONCLUSIONS

In an effort to clarify the concept of animism, a series of questions designed to determine what the child means when he states that an object is alive was administered to 150 school children. The following results are indicated:

1. Subjects much more frequently stated that inanimate objects were alive than they attributed sensory and functional attributes to these objects.

2. From kindergarten through grade 7 there was a progressive decrease in the number of subjects who stated that inanimate objects which did *not* evince activity were alive. There was a parallel trend toward a progressive decrease in the number of sensory and functional attributes assigned to these objects.

3. From kindergarten to grade 1 there was a decrease in the number of subjects who stated that inanimate objects which *did* evince activity were alive, after which there was a marked increase at grade 3, and again at grade 5, followed by a decrease at grade 7. There was *not* a parallel trend in the number of sensory and functional attributes assigned to these objects.

4. After answering the allied questions, there was a marked reduction in the number of subjects who stated that the six inanimate objects were alive, but in general the above-mentioned trends (2 and 3) were sustained.

In the opinion of the author, the child's statement that a certain object is alive is an inadequate measure of animism. Data indicating that many children as old as 14 years are still quite animistic have resulted when this measure was employed. It is felt that data regarding what the child terms *alive* are more revealing of the child's usage of the term *alive* than a measure of animism. The present data indicate that when a child states that an inanimate object is alive, particularly an object which evinces activity, he means much less by this term than most adults do, and much less than Piaget seems to have implied that the child means.

Bibliography

1. Bruce, Myrtle. Animism vs. evolution of the concept "alive." *J. Psychol.*, 1941, 12, 81-90.
2. Granich, L. A qualitative analysis of concepts in mentally deficient schoolboys. *Arch. Psychol., N.Y.*, 1940, No. 251, 1-47.
3. Huang, I., and Lee, H. W. Experimental analysis of child animism. *J. genet. Psychol.*, 1945, 66, 69-74.
4. Johnson, E. C., and Josey, C. C. A note on the development of the thought forms of children as described by Piaget. *J. abnorm. soc. Psychol.*, 1931, 26, 338-39.
5. Piaget, J. *The child's conception of the world.* New York: Harcourt, Brace, 1929.
6. Russell, R. W. Studies in animism: II. The development of animism. *J. genet. Psychol.*, 1940, 56, 353-366.
7. Russell, R. W. Studies in animism: IV. An investigation of concepts allied to animism. *J. genet. Psychol.*, 1940, 57, 83-91.
8. Russell, R. W., and Dennis, W. Studies in animism: I: A standardized procedure for the investigation of animism. *J. genet. Psychol.*, 1939, 55, 389-400.

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YOUNG CHILDREN'S RESPONSES TO A PICTURE AND INSET TEST DESIGNED TO REVEAL REACTIONS TO PERSONS OF DIFFERENT SKIN COLOR

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What do differences in skin color mean to young children? Incidental observations in university nursery schools suggest that there is little awareness of the racial significance of skin color.

Three-year-olds in a midwestern nursery school, noting the daily appearance of a Negro maid to pick up one of the children, called to him, "Here's your mother." Four-year-olds, in a western nursery school a few days following Pearl Harbor, ran around the yard with a newly enrolled Japanese boy, unitedly bombing "Japs." The skin color of their playmate and his mother excited no comment.

Children in these university nursery schools were, however, a somewhat selected group. Their parents in most cases were college graduates. Their fathers were engaged in professions or in occupations of managerial or executive type. Their homes, if not in the best residential areas, were at least in desirable ones.

Clark and Clark (2), Helgerson (6), Radke, Trager, et al. (11, 12), dealing primarily with children of low socio-economic status, report that by five years of age skin color is perceived as possessing both racial and social significance.

In the light of this divergent evidence, the present study was undertaken with the purpose of exploring the significance of family economic and social circumstances on young children's responses to persons of different skin color.

Table 1 summarizes information concerning age, sex, ethnic group, and socio-economic status of the children in the study.

It was originally intended to include groups of children with and without ethnic group experience in school, and to compare responses of Negro and white children of upper as well as lower socio-economic status. However, preliminary inquiry revealed that schools were either Negro or white with a negligible percentage of children of the other race in attendence, and that there were no Negro groups which could be considered comparable with the white upper socio-economic groups.

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TABLE I

FREQUENCY OF CASES STUDIED, CLASSIFIED ACCORDING TO AGE, SEX, ETHNIC GROUP, AND SOCIO-ECONOMIC STATUS

		Lower Socio-Economic Status		Upper Socio-Economic Status	
Age	*Sex*	*Negro*	*White*[*]	*White*[†]	*Totals*
3 years	Male	24[*]	24	24	72
3 years	Female	24[*]	24	24	72
5 years	Male	24[‡]	24	24	72
5 years	Female	24[‡]	24	24	72
		96	96	96	288

[*] All from San Francisco.
[†] All from Berkeley.
[‡] All from Oakland.

Socio-economic classification was based on parents' ocupation, education, and housing, and on the median I.Q. of the children. In both the three- and five-year-old upper socio-economic groups, over half the parents were engaged in professions; approximately one-third occupied managerial positions. The residential area from which both groups were drawn was the most desirable in the community. It was, incidentally, not ethnically exclusive. Median I.Q. for the three-year-olds was 128, for the five-year-olds, 121.

In both the three- and five-year-old white lower socio-economic groups, more than one-half the children's parents were engaged in unskilled, semi-skilled, and skilled labor, and some were unemployed. The three-year-olds attended a state supported child care center where enrollment was restricted to low income families in which it was necessary for the mother to work. Residential areas for both groups were among the less desirable in the community. They were within or bordering ethnically mixed neighborhoods. Median I.Q. for the three- and the five-year-old group was approximately 100.

Both three- and five-year-old Negro children had parents whose occupations and housing facilities approximated, but were at a slightly lower level than those of the white low socio-economic group. The three-year-olds attended the state child care centers. Both three- and five-year-olds lived in congested industrial areas in which sub-standard housing was common. The five-year-olds lived in an exclusively Negro neighborhood, the three-year-olds in a predominantly Negro neighborhood. Mental test scores were not available for either group of children.

The terms upper and lower class, used for the sake of brevity in this study, therefore distinguish, on the basis of fathers' occupation, between a professional or executive group and a group of semiskilled or unskilled workers.

The Picture and Inset Test

Research literature on test performance (3, 13), perception (1), and reasoning (4, 5) in young children suggests the nature of the problems to be solved in devising a test suitable for children with an age span from 36 to 71 months.

Table 2

PICTURE INSET SERIES FOR BOYS

PICTURE FIGURE		INSET FIGURE			
Skin Color — White			*White*	*Brown*	*Black*
1A*	Boy	Boy	a†	b†	c†
2A	Boy	Baby	a	b	c
3A	Boy	Woman	a	b	c
4A	Boy	Man	a	b	c
5A	Woman	Man	a	b	c
6A	Girl	Girl	a	b	c
Skin Color — Brown			*White*	*Brown*	*Black*
1B*	Boy	Boy	a	b	c
2B	Boy	Baby	a	b	c
3B	Boy	Woman	a	b	c
4B	Boy	Man	a	b	c
5B	Woman	Man	a	b	c
6B	Girl	Girl	a	b	c
Skin Color — Black			*White*	*Brown*	*Black*
1C*	Boy	Boy	a	b	c
2C	Boy	Baby	a	b	c
3C	Boy	Woman	a	b	c
4C	Boy	Man	a	b	c
5C	Woman	Man	a	b	c
6C	Girl	Girl	a	b	c

*ABC refers to skin color of figure in picture.

† abc refers to skin color of figure in inset.

1 - 6 refers to picture and inset person-combination, thus picture "3A" completed with inset "a" portrays a white boy with a white woman.

A picture and inset test requiring the choice of one of a pair of insets to complete a picture seemed the most satisfactory solution. It was clear immediately, however, that to be within the comprehension of three-year-olds of average or lower intelligence the picture content would have to be familiar and neutral in feeling tone. Two series of pictures were therefore developed, one for boys and one for girls. Each series contained 18

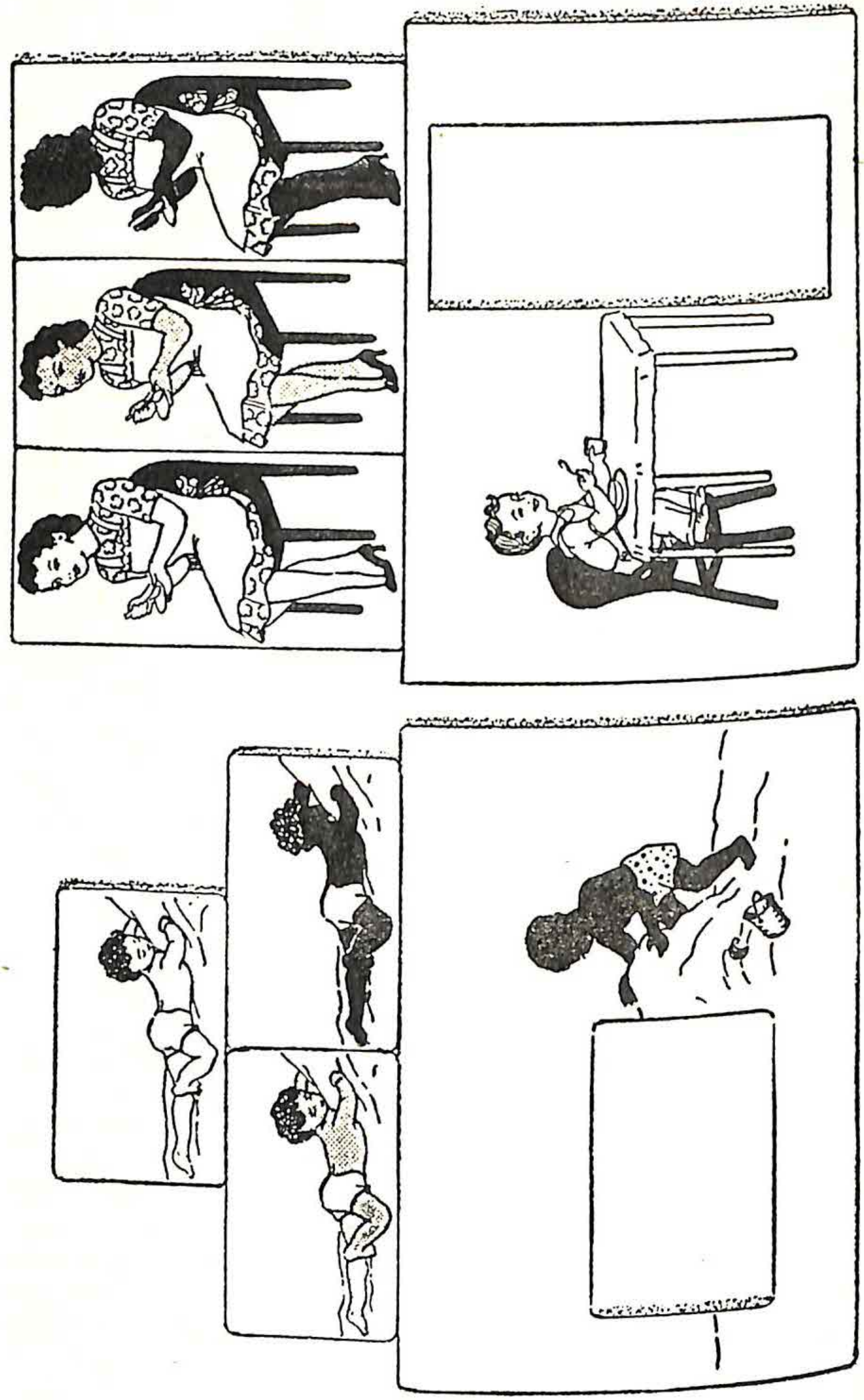

Figure 1—Two of the picture and inset person-combinations used in the inset test.

pictures which when completed with an inset showed two persons in such familiar activities as playing, eating, bathing, riding, walking, and waking up in the morning. Each picture had three accompanying insets identical in all respects save skin color. Table 2 indicates the person-combinations represented.

TABLE 3

FACTORS HELD CONSTANT IN PRESENTATION OF 54 PAIRS OF INSETS

Presentation	*Skin Color of Figure in Inset*	Number Presented *Total*	*Right*	*Left*	Matching Possibilities *Total*	*Right*	*Left*
First	White a	12	6	6	4	2	2
	Brown b	12	6	6	4	2	2
	Black c	12	6	6	4	2	2
Second	White a	12	6	6	4	2	2
	Brown b	12	6	6	4	2	2
	Black c	12	6	6	4	2	2
Third	White a	12	6	6	4	2	2
	Brown b	12	6	6	4	2	2
	Black c	12	6	6	4	2	2
Total	White a	36	18	18	12	6	6
	Brown b	36	18	18	12	6	6
	Black c	36	18	18	12	6	6

Eighteen matching choices possible on the right and on the left.

Equal occurrence of each permutation: ab ac bc, ba ca cb.

Each picture matched once on right, once on left.

Each picture and inset person-combination presented with a white, a brown, and a black skinned figure on the right hand and on the left in each presentation.

Construction details concerning the pictures are that they were painted with a quick drying lacquer on 12" x 15" masonite rectangles and finished with a clear shellac on both sides. Colors chosen were recommended by the University Decorative Art Department as being equally pleasing with white, brown, and black skins. Negro facial characteristics other than skin color were suggested but not emphasized. Slight variations in background and clothing were made for the six A, B, and C pictures and insets so that children might not tire of them. For instance, 1A shows two boys piling blocks in a wagon; 1B, two boys on a rocking boat; and 1C, two boys making a sand castle. Figure 1 shows two different picture and inset person-combinations. Inset figures are light white in one, black in one, and brown in another inset.

PRESENTATION OF PICTURES AND INSETS

All presentation factors which, in preliminary tests, seemed to affect children's choice of insets were held constant. See Table 3. A recent article (8) discusses in detail the need for this procedure. A sample form of the check and tabulation sheet used for individual children is shown in the Appendix.

Each of the eighteen pictures was presented on three separate occasions with one of the three possible pairings of insets. A young white woman tested the six groups of children. While a question may be raised concerning the effect of a white tester on Negro children, the alternative of a Negro for Negro children and a white tester for white children would also have introduced a social variable. Incidentally, both three- and five-year-old Negro children had white teachers.

In presenting the pictures the tester said, in the case of the first picture, "Here is a picture of two boys playing. Which of these boys (indicating the insets) would you like to put in?" The child's choice of insets was circled and any spontaneous comments recorded.

DATA AVAILABLE FROM RESPONSES TO PICTURE AND INSET TEST

The number of times each child could choose a figure of white, brown, or black skin color is summarized in Table 4. Also summarized are the number of times in which skin color of a figure in one of the insets matched that in the picture and the number of times neither inset matched in this way.

The data thus make possible group, age, and sex comparisons of total skin color choices, of matching skin color choices, and of skin color choices when neither inset matched picture skin color. In addition, it is possible to compare skin color choices in terms of different persons represented in the inset, and of first and third presentation of the series. As a pair of insets necessarily assume a right and left position, it is also possible to

TABLE 4

NUMBER OF TIMES INSETS PORTRAYING DIFFERENT SKIN COLORS WERE PRESENTED

Type of Paired Presentation	*Skin Color of Inset Figures*			*Total Paired Presentations*
	White	Brown	Black	
Matching Member of Pair ..	12	12	12	36
Non-Matching Member of Pair	12	12	12	..
Member of Pair of Non-Matching Insets	12	12	12	18
Member of Pair	36	36	36	54

compare children's right and left choices. Supplementary information includes analysis of children's spontaneous comments during presentation of series.

TABLE 5

PERCENTAGES OF TIMES SKIN COLOR WAS CHOSEN WHEN PRESENTED AS A MEMBER OF A PAIR*

			Skin Color Choice		
Age Years	*Sex*	*Social Group*	*White* %	*Brown* %	*Black* %
5	Boys	White Upper Class	49.3	58.1	42.6
5	Boys	White Lower Class	64.1	54.2	31.7
5	Boys	Negro Lower Class	68.1	55.0	26.5
3	Boys	White Upper Class	46.8	53.8	49.4
3	Boys	White Lower Class	59.6	45.8	44.6
3	Boys	Negro Lower Class	62.1	50.9	36.6
5	Girls	White Upper Class	51.0	57.0	41.9
5	Girls	White Lower Class	58.1	54.3	37.7
5	Girls	Negro Lower Class	66.0	53.1	30.8
3	Girls	White Upper Class	56.8	51.4	41.7
3	Girls	White Lower Class	51.7	52.0	46.3
3	Girls	Negro Lower Class	59.6	53.7	36.7

*In each of 12 groups of 24 children, there were 864 opportunities to choose each skin color when presented as a member of a pair.

RESULTS

Total skin color choices. Table 5 summarizes children's choices of skin color when presented as a member of a pair. Scores for each of the 12 groups of children are based on 864 choices.

Social group differences show a consistent pattern for three- and five-year-old boys and five-year-old girls. Choice of white skin by groups shows the following descending order of frequency: Negro, white lower class, white upper class. Choice of black skins shows a reverse order: white upper class, white lower class, Negro.

The departure from this pattern shown by the white three-year-old girls may be ignored because none of the differences between upper and lower class white girls are statistically significant.

Age differences are reflected in an increase in choice of white (by all groups save the white upper class girls), an increase in choice of brown (by all save Negro girls), and a decrease in choice of black (in all save white upper class girls).

Sex differences reveal an interesting reversal in boys' and girls' choices of white and black skin color when white upper are compared with white lower class and Negro groups. In the upper class white groups, girls make more choices of white and fewer choices of black skin color than boys. In the lower class white and Negro groups, girls make fewer choices of white and more choices of black skin color than the boys.

It is not psychologically meaningful to compute measures of significance for the differences summarized, because two factors contributed to them—children's interest in matching and their interest in skin color *per se*. It is therefore necessary to examine and compare children's responses when only one of these factors was operating. Reference to Table 4 shows that white, brown, and black skin color could each be chosen twelve times as a match for the skin color of the figure in the picture. White, brown, and black skin color could also be chosen twelve times when neither pair of insets matched skin color of the figure in the picture.

Matching skin color choices. Total matching choices (Table 6) show consistent group differences at both ages and for both sexes. The white upper class groups match most, the Negroes least, and the white lower class groups are intermediate.

Tests of the statistical significance of differences in matching choices by the various sex, age, social, and ethnic groups showed that

TABLE 6

PERCENTAGE OF TIMES CHILDREN MATCHED SKIN COLOR WHEN POSSIBLE*

Age Years	*Sex*	*Group*	*White* %	*Brown* %	*Black* %	*Range*† %	*Total* %
5	Boys	White Upper	81.1	74.1	73.1	8.0	75.6
5	Boys	White Lower	79.2	60.4	47.2	32.0	62.3
5	Boys	Negro Lower	74.7	59.0	30.5	44.2	54.7
3	Boys	White Upper	61.5	60.8	62.9	2.1	61.3
3	Boys	White Lower	70.1	53.1	51.7	18.4	59.5
3	Boys	Negro Lower	66.7	53.5	46.2	20.5	54.2
5	Girls	White Upper	80.8	73.8	73.1	7.7	75.3
5	Girls	White Lower	79.2	66.0	58.0	21.2	67.7
5	Girls	Negro Lower	69.1	57.3	37.2	31.9	54.5
3	Girls	White Upper	67.8	59.1	55.3	12.5	60.4
3	Girls	White Lower	64.6	59.3	56.6	8.0	60.2
3	Girls	Negro Lower	65.3	55.2	42.0	23.3	55.4

* In each of 12 groups of 24 children, there were 288 opportunities to match each skin color when presented as a member of a pair.

† Range refers to difference or spread between highest and lowest percentage obtained by a group for different skin color choices.

(1) There are no significant sex differences.

(2) As far as age differences are concerned, those for Negroes are not significant.

Among the white children,

(*a*) Lower class white children show only a slight tendency ($p = .10$) for older girls to match more than younger girls.

(*b*) Upper class white children show significant age differences. Older girls match more than younger girls ($p = .01$). Older boys to a lesser extent ($p = .05$) match more than younger boys.

(3) Regarding differences between social classes, the three-year-olds show no significant differences.

Among the five-year-olds,

(*a*) Negro girls match significantly less frequently ($p = .01$) than upper white and lower white class girls.

(*b*) Negro boys match significantly less frequently ($p = .01$) than white upper class boys, but not less frequently than white lower class boys.

(*c*) Between white upper and lower class boys and girls there is some tendency ($p = .05$) for upper class boys to match more than lower class boys, and a lesser tendency ($p = .10$) for upper class girls to match more than lower class girls.

Tentatively one might explain social group differences on the basis of differences in intelligence levels. Ability to distinguish likeness and difference is a part of mental test performance. However, the picture series was not presented as a problem in distinguishing likeness and difference. Therefore, a high total matching score must be interpreted as lack of concern for skin color *per se*. This interpretation is supported by the relative frequency of matching the three skin colors by the three social groups.

The ranges in matching scores for the three skin colors (see Table 6) show (with the exception of the white three-year-old girls) consistent social group differences at both ages and for both sexes. Differences between these ranges suggest group differences in response for the different skin colors (save for the three-year-old girls). Apparently, the white upper class groups perceive the picture and inset series as a *matching problem*.

The lower white groups, though revealing a tendency to match skin color, show (with the exception of the three-year-old girls) a significant difference in the number of times they match white rather than brown or black skin color. To these children the picture and inset series is apparently perceived as a *problem involving skin color preferences as well as matching*.

The Negroes whose matching responses are not much above chance expectancy show significant differences in choice of white over black,

Table 7

SIGNIFICANCE OF DIFFERENCES* IN MATCHING INSET AND PICTURE SKIN COLORS

Age Years	*Sex*	*Group*	*White–Black* *p*	*White–Brown* *p*	*Brown–Black* *p*
5	Boys	White Upper	—	—	—
5	Girls	White Upper	—	—	—
5	Boys	White Lower	.01	.01	—
5	Girls	White Lower	.01	.05	—
5	Boys	Negro Lower	.01	.10	.01
5	Girls	Negro Lower	.01	.05	.01
3	Boys	White Upper	—	—	—
3	Girls	White Upper	.05	.10	—
3	Boys	White Lower	.01	.01	—
3	Girls	White Lower	—	—	—
3	Boys	Negro Lower	.01	.05	—
3	Gilrs	Negro Lower	.01	.05	.10

* Based on a modification of Wilcoxon's rank test (7, 9, 15).
— indicates figures greater than .10.

white over brown, and even brown over black. To them the series is apparently perceived as a *problem in skin color preference.*

As will be discussed later, children's spontaneous verbalizations supported these interpretations of their choices.

Tables 7 and 8 reveal that patterns of response and differences between social groups become more significant with age. The Negro children appear to show the least change of the three groups. This suggests that environmental influences affecting children's responses to skin colors may be effective earlier in the Negro than in the white groups.

Slight but non-significant sex differences appear to be dependent on socio-economic status in white three-year-olds. Upper white girls and lower white boys show a more selective response to white skin color than upper white boys and lower white girls. This finding recalls Goodenough's (3) report that sex differences in social behavior in a mental test situation were dependent on socio-economic status of the children.

Skin color choices when matching was not possible. Brown skin color choices could result from *attempts to match* as well as from skin color preferences *per se.* In the 18 presentations in which it was not possible to match, the picture and inset skin colors were as follows:

No. of Presentations	*Pictures*	*Inset*
6	A	b c
6	B	a c
6	C	b a

TABLE 8

SIGNIFICANCE* OF SOCIAL GROUP, AGE AND SEX DIFFERENCES IN MATCHING SKIN COLORS

SOCIAL GROUP DIFFERENCES

	White			*Brown*			*Black*		
	WU-WL	WU-NL	WL-NL	WU-WL	WU-NL	WL-NL	WU-WL	WU-NL	WL-NL
Age Sex	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*
5 yr Boys	—	—	—	.05	.05	—	.01	.01	.10
5 yr Girls	—	.05	.05	—	.01	.10	.05	.01	.01
3 yr Boys	.05	—	—	—	—	—	—	.05	—
3 yr Girls	—	—	—	—	—	—	—	—	.10

AGE DIFFERENCES

Sex	*Group*	*White* *p*	*Brown* *p*	*Black* *p*
Boys	White Upper	.01	.05	—
Boys	White Lower	.10	—	—
Boys	Negro Lower	.10	—	.05
Girls	White Upper	.05	.01	.05
Girls	White Lower	.05	—	—
Girls	Negro Lower	—	—	—

SEX DIFFERENCES

Age Years	*Group*	*White* *p*	*Brown* *p*	*Black* *p*
5	White Upper	—	—	—
5	White Lower	—	—	—
5	Negro Lower	—	—	—
3	White Upper	—	—	—
3	White Lower	—	—	—
3	Negro Lower	—	—	—

* Based on a modification of Wilcoxon's rank test (7, 9, 15).
— indicates figures greater than .10.

These combinations make possible 12 near matches with brown, 6 with white, 6 with black. For example, when A is presented with b c, b, the brown skin, is a near match to white compared with c, the black skin. Spontaneous comments of the upper class white children revealed their attempts at near matching. "This is the closest I can get" is typical.

TABLE 9

PERCENTAGE OF TIMES CHILDREN CHOSE SKIN COLOR WHEN NEITHER INSET MATCHED PICTURE SKIN COLOR[*]

Age Years	*Sex*	*Social Group*	*White* %	*Brown* %	*Black* %	*White-Black Range*[†] %
5	Boys	White Upper	40.6	76.0	33.3	7.3
5	Boys	White Lower	59.4	62.2	28.4	31.0
5	Boys	Negro Lower	66.7	54.5	28.8	37.9
3	Boys	White Upper	36.1	64.2	49.6	13.8
3	Boys	White Lower	58.3	46.2	45.5	12.8
3	Boys	Negro Lower	61.1	56.3	32.6	28.5
5	Girls	White Upper	43.1	74.7	32.3	10.8
5	Girls	White Lower	48.3	66.3	35.4	12.9
5	Girls	Negro Lower	67.3	52.8	29.8	37.5
3	Girls	White Upper	48.6	62.8	38.5	10.1
3	Girls	White Lower	48.6	56.3	45.1	3.5
3	Girls	Negro Lower	57.9	57.9	34.0	23.9

[*] In each of 12 groups of 24 children, each skin color was presented 288 times as a member of a pair.

[†] Range refers to difference or spread between percentages of choices for black and for white skins.

Because measures of significance of group differences in brown skin choices would not be psychologically meaningful, group ranges and measures of significance are presented only for white and black skin choices (see Tables 9 and 10).

They are as follows:

Ranges of choice for white and black skin colors shows consistent social group differences at five years for both sexes. The Negroes at both ages and of both sexes show the greatest discrimination between white and black. At the five year level, upper whites show the least discrimination and the lower whites are in an intermediate position between upper whites and Negroes.

For white skins a consistent descending order of frequency was obtained at both ages and for both sexes—Negroes greatest number of choices, upper whites least, lower whites intermediate.

The significance of social group, age, and sex differences obtained are summarized in Table 10.

White skins are chosen significantly more often by Negroes than upper whites at both ages, and by both sexes at five years. White skins are also chosen significantly more often by lower white boys than upper white boys of both ages, and by Negro than lower white five-year-old girls.

Table 10

SIGNIFICANCE[*] OF DIFFERENCES IN SKIN COLOR CHOICES WHEN NEITHER INSET MATCHED PICTURE IN SKIN COLOR

Social Group Differences

Age Years	*Sex*	*White Upper — White Lower* *p*	*White Upper — Negro Lower* *p*	*White Lower — Negro Lower* *p*
White Skin Color				
5	Boy	.05	.01	—
5	Girl	—	.01	.05
3	Boy	.01	.01	—
3	Girl	—	.10	—
Black Skin Color				
5	Boy	—	—	—
5	Girl	—	—	—
3	Boy	—	.01	.05
3	Girl	—	—	.05

Age Differences

Sex	*Social Group*	*White Skin Color* *p*	*Black Skin Color* *p*
Boys	White Upper	—	.01[†]
Boys	White Lower	—	.01[†]
Boys	Negro Lower	—	—
Girls	White Upper	—	—
Girls	White Lower	—	—
Girls	Negro Lower	—	—

Sex Differences

Age	*Social Group*	*White Skin Color* *p*	*Black Skin Color* *p*
5	White Upper	—	—
5	White Lower	—	—
5	Negro Lower	—	—
3	White Upper	.05[‡]	—
3	White Lower	—	—
3	Negro Lower	—	—

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[*] Based on a modification of Wilcoxon's rank test (7, 9, 15).

— indicates figures greater than .10.

[†] Choice of black decreased with age.

[‡] Greater preference for white skin by girls.

Differences in black skin choices are significant at the three year level only. Negro boys choose black skin color significantly less frequently than upper white and lower white boys. Negro girls choose it significantly less frequently than lower white girls.

Upper and lower white boys show a decrease in choice of black skin with age. Upper white three-year-old girls choose white skins more often than upper white boys.

Briefly, children's skin color choices, when matching is not possible, confirm the social group and age tendencies already noted.

Table II

FREQUENCY OF SPONTANEOUS COMMENTS OF CHILDREN WITHIN EACH AGE, SOCIAL-GROUP CATEGORY

	Five-Year-Olds			Three-Year-Olds			
	White Upper 16 boys 17 girls	*White Lower* 14 boys 14 girls	*Negro Lower* 9 boys 10 girls	*White Upper* 11 boys 12 girls	*White Lower* 8 boys 6 girls	*Negro Lower* 8 boys 9 girls	*Total*
Similarities Matching: "This is a black lady just like that boy. It matches."	139	75	38	62	12	5	331
Simple description of color: "The baby's white. That's a brown girl."	59	42	22	32	32	41	228
Preference: "She's a good lady. I like to choose white."	19	8	24	5	3	7	66
Preference and Hostility: "That's a bad daddy, I want the good daddy."	5	4	4	0	1	18	32
Hostility: "I don't like this kind. That lady is too brown."	1	0	6	1	1	16	25
Totals for preference and hostility	25	12	34	6	5	41	123
Use of racial terms	49	15	0	10	0	0	74
Causation of Color: "She got dirty. My baby brother is lighter. He doesn't stay in the sun so much."	9	8	2	3	0	1	23
Unclassified	3	0	0	7	0	0	10
Totals	284	152	96	120	49	88	789

Before summarizing, some supplementary data are worth consideration.

Spontaneous comments of children. As only some of the children tested spoke, and as some groups had more speakers than others, reliable intergroup comparisons are not possible. Table 11 reveals that the white upper class children made the greatest number of comments about matching at both ages, and that the Negroes at both ages made the greatest number of remarks showing preference for white and hostility to dark skins.

Comparison of children's skin color choices in terms of the person represented. When rank orders were determined for the frequency with which children chose insets of different skin color in terms of the six different persons represented in the insets, no discernible pattern of response was evident. It is possible, however, that in a southern state children's choice of skin color may be affected by the person represented.

Comparison of children's skin color choices in first and third presentation of the series. Differences were so slight and inconsistent in terms of social group, age, and sex variables that it seems unlikely that increasing familiarity with the series affects children's choices of skin colors.

Choices of inset to child's right. As the summary (Table 12) indicates, any study involving a choice of objects which assume a right-left position in relation to young child subjects must control this variable, particularly with children as young as three years.

TABLE 12

PERCENTAGE OF TIMES INSET ON CHILD'S RIGHT WAS CHOSEN

Age	*Social Group*	*Boys* 1296 Choices %	*Girls* 1296 Choices %	*Total* 2592 Choices %
5	Upper White	51.9	52.2	52.1
5	Lower White	51.7	51.7	51.7
5	Negro	55.9	58.4	57.2
3	Upper White	58.0	63.9	60.9
3	Lower White	66.4	59.2	62.8
3	Negro	63.0	58.2	60.5

SUMMARY

Forty-eight three- and five-year-old children of white upper, white lower, and Negro lower socio-economic status (228 in all) were presented with a picture and inset test designed to reveal reactions to persons of white, brown, and black skin color.

The test required each child to make 54 choices of one of a pair of insets to complete a picture. In 36 choices one of the insets matched the picture in skin color of the person represented, in 18 neither inset did. Children's choices revealed social group, age, and sex differences in patterns of response which appeared to reflect environmental influences dependent on socio-economic status.

The white upper class groups apparently perceived the picture inset series as a matching problem. They made more matching responses at each age level than the white lower class and Negro groups. They also made more comments about matching than the other two groups. Social group differences in matching choices were all significant at the five year level. The upper class whites also showed no significant differences in their choice of skin colors, indicating that skin color *per se* was not perceived as an important factor in their choice.

The white lower class groups resembled the Negroes in showing significant differences in their choice of white skins when paired with brown or black skins. Though they showed a greater tendency to match than the Negroes, there were significant differences in their matching choices for different skin colors. In this group, skin color was apparently perceived as an important and determining factor in their choice of inset.

The Negro groups showed little more than chance frequency in matching skin colors but did show significant differences in choice of white over black, white over brown, and even brown over black skin color. They also made more comments expressing preference and hostility for different skin colors.

Age differences in each group were, in general, in terms of accentuation of a group pattern already present at three years. For example, preference for white skin color in the white lower class group became more significant at five years than at three, and preference for brown over black in the Negroes showed a similar trend in increased significance. Age differences were less marked for the Negroes than the other two groups, suggesting that environmental influences directing attention to skin color may be effective earlier in Negro than in white groups.

Sex differences, though only significant in one comparison for upper white three-year-olds suggested some relationship with socio-economic status. White upper class girls and lower class boys showed more preference for white skins than white lower class girls and upper class boys.

The implications of the findings would seem obvious. Patterns of response to persons of different skin color are present as early as three years and become accentuated during the succeeding two years. Though living in a democracy, many Negro citizens apparently learn by three years of age that skin color is important, that white is to be desired, dark to be regretted. As for the white skinned citizens, what they learn in their first five years about skin color appears to be related to their parents' occupation, education, intelligence, and residential neighborhood. Young children of parents engaged in professions perceive skin color in cognitive terms, children of parents engaged in semi-skilled occupations perceive it in affective terms.

The writers prefer to delay interpretation of these group differences until similar groups of children in a southern state have been tested.

References

1. Brian, C. R., and Goodenough, F. L. The relative potency of color and form perception at different ages. *J. exp. Psychol.*, 1929, 12, 197-213.
2. Clark, K. B., and Clark, Y. K. The development of consciousness of self and the emergence of racial identification in Negro preschool children. *J. soc. Psychol.*, 1939, 10, 591-599.
3. Goodenough, F. L. The emotional behavior of young children during mental tests. *J. juv. Res.*, 1929, 13, 204-219.
4. Heidbreder, E. F. Reasons used in solving problems. *J. exper. Psychol.*, 1927, 10, 397-414.
5. Heidbreder, E. F. Problem solving in children and adults. *J. genet. Psychol.*, 1928, 35, 522-554.
6. Helgerson, E. The relative significance of race, sex, and facial expression in choice of playmate by the preschool child. *J. Negro Educ.*, 1943, 12, 617-622.
7. Hemelrijk, J. Note on Wilcoxon's two sample tests when ties are present. *Ann. Amer. Stat.*, 1952, 23, 133-135.
8. Landreth, C., and Platt, E. F. A problem in factorial design: The development of a picture and inset test for determining children's response to persons of different skin color. *J. educ. Psychol.*, 1951, 42, 385-398.
9. Mann, H. B., and Whitney, D. R. On a test of whether one of two random variables is stochastically larger than the other, *Ann. Math. Statist.*, 1947, 18, 50-60.
10. Platt, E. F. Young children's responses to differences in skin color. Unpublished Master's thesis, Univ. Calif., 1950.
11. Radke, M. J., Trager, H. S., and Davis, H. Social perceptions and attitudes of children. *Genet. Psychol. Monog.*, 1949, 40, 327-447.
12. Radke, M. J., and Trager, H. S. Children's perceptions of the social roles of Negroes and whites. *J. Psychol.*, 1950, 29, 3-33.
13. Rust, M. M. The effect of resistance on intelligence test scores of young children. *Child Develpm. Monogr., Teachers College, Columbia Univ.*, 1931, No. 6.
14. Schmidt, W. H. A determination by a projective technique of young children's responses to persons of different skin color, using fifty white three-year-old children of upper socio-economic status. Unpublished Master's thesis, Univ. Calif., 1948.
15. Wilcoxon, F. Individual comparisons by ranking methods. *Biometrics Bull.*, 1945, 1, 80-83.

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APPENDIX

CHECK AND TABULATION SHEET USED FOR INDIVIDUAL CHILDREN

Young Children's Responses to People of Different Skin Color

Child's Name ____________________
Parent's Occ. ____________________
Address ____________________
School ____________________
Experimenter ____________________

Age ____________________
Sex ____________________
Skin Color ____________________
School Group ____________________
Teacher ____________________

			Did Match			No Match			Summary					
	Picture	R L	a	b	c	a	b	c						
Person	1 A	b a												
	2 C	c a												
DATE	3 B	a c												
	4 A	b c												
	5 B	b a												
	6 C	b c												
Relative	1 B	c b												
	2 A	a b												
	3 C	b a												
	4 B	c a												
	5 C	c b												
	6 A	c a												
Person	1 C	a c												
	2 B	b c												
	3 A	c b												
	4 C	a b												
	5 A	a c												
	6 B	a b												
	Total													
Relative	1 B	a c												
	2 A	b c												
DATE	3 C	c b												
	4 A	c a												
	5 C	a c												
	6 B	b c												
Person	1 A	c b												
	2 C	a b												
	3 B	b a												
	4 C	b c												
	5 B	c b												
	6 A	a b												
Relative	1 C	b a												
	2 B	c a												
	3 A	a c												
	4 B	a b												
	5 A	b a												
	6 C	c a												
	Total													
Person	1 C	c b												
	2 B	a b												
DATE	3 C	a c												
	4 A	a b												
	5 C	b a												
	6 B	c a												
Relative	1 A	a c												
	2 C	b c												
	3 A	b a												
	4 B	b c												
	5 A	c b												
	6 C	a b												
Person	1 B	b a												
	2 A	c a												
	3 B	c b												
	4 C	c a												
	5 B	a c												
	6 A	b c												
	Total													
	Totals													

Preference

1	2	3	4	5	6		
						a	
						b	
						c	

						a	
						b	
						c	

						a	
						b	
						c	

						a	
						b	
						c	

Totals

Negro Ident.

B	G
a	a
b	b
c	c

Color Ident.

1	
2	
3	

Match	A							
	B							
	C							

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THE BODY SIZE AND FORM OF PRESENT-DAY WHITE ELEMENTARY SCHOOL CHILDREN RESIDING IN WEST-CENTRAL OREGON

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Prior to 1950 the literature on physical growth did not include any research pertaining to the body size or body form of white school children living in the northwestern part of the United States, i.e., in the region north of latitude 42° N and west of longitude 100° W. During the period 1950-52 the first author organized aud supervised a research program on white school children residing in west-central Oregon.[1]

Portions of the findings from the program have been reported in four previous papers (9, 10, 14, 18). Two of these papers dealt with the body size and form of junior high school boys (14, 18), one with the body size of elementary school boys of northwest European ancestry belonging to different socioeconomic categories (9), and one with the size and form of elementary school "Oregon-raised boys of not less than third generation American white stock" (10, p. 39).

This paper, the fifth and last of the series, characterizes 16 traits of size and form on "the general run" of present-day white boys and girls attending public elementary schools in west-central Oregon. Samples were drawn to represent boys at ages 7 and 10 years, and girls at ages 7, 9, and 11 years.

SUBJECTS

The subjects were obtained in the 22 public elementary schools of Eugene, Junction City, and Cottage Grove.[2] Boys were measured in the spring and fall of 1950, girls in the fall of 1951 and spring of 1952. Always the anthropometric examinations were made within 2 months of a child's birthday, e.g., the boys and girls taken to represent age 7 years ranged in exact age from 6 years 10 months 0 days to 7 years 1 month 30 days.

In preparing to work at a particular school, the first step was that of obtaining a list of all white children enrolled who satisfied the sex and age criteria. A letter was sent to the parents of each child listed explaining the

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[1] This program was supported by the University of Oregon. Grateful acknowledgment is tendered for a professorial research appointment over the period 1949-52 in the School of Health and Physical Education, and for three grants-in-aid from the Graduate School.

[2] Thanks are due the school superintendents, principals, and teachers for making the subjects available and helping in other ways. Special gratitude is expressed to Madeline Marr, M.D., Director of Health Services for the Eugene School District.

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study and requesting consent to the child's participation. For all schools and both sexes combined, 970 letters went out and approval was secured except in 18 instances.

It was later necessary to reject an additional 11 children on whom complete records could not be obtained satisfactorily due to various kinds of body pathology. It follows that the actual number of subjects is 941. In the five separate age-sex subgroups there are 260 boys age 7 years, 208 boys age 10 years, 168 girls age 7 years, 160 girls age 9 years, and 145 girls age 11 years.

Practically all of the subjects were born in North America; 95 per cent were born west of the Mississippi River; and over 50 per cent had resided continuously in Oregon from birth. More than 90 per cent of the children were of northwest European lineage, while approximately 50 per cent were descendants of immigrants from the British Isles. The scattering of children having south and/or east European ancestors in most instances also had one or more grandparents of northwest European ethnic background.

Measurements

The anthropometric examinations were made during school hours, with the full cooperation of school staff, parents, and children. The necessary instruments—including stature board and square, wood and metal calipers, standard bench, steel tape, and weighing scales—were transported to each school and arranged for convenient use in a well lighted and comfortably heated room. Children were measured individually, wearing only shorts or panties at the time body weight was determined and, in the case of the other measurements, wearing nothing which prevented each instrument from making direct contact with the nude body.

Detailed specification of the anthropometric procedures used in obtaining the different measurements has been presented in an earlier publication (10). Hence, it will suffice here to give a succinct identification of each measurement.

Stature (vertex-soles distance). Erect body height taken with the subject's heels, buttocks, and upper part of back in contact with an upright board.

Stem length (vertex-rump distance). Maximum distance from the vertex to the upper surface of an anthropometric bench on which the subject was oriented in an erect sitting position.

Shoulder width (biacromial diameter). Transverse distance between the most lateral points of the acromion processes, with the shoulders in normal orientation.

Hip width (bi-iliocristal diameter). Transverse distance between the lateralmost projections of the crests of the ilia, applying firm pressure against the overlying tissues.

Chest girth (xiphisternal level). Circumference of the thorax, at the level of the xiphisternal junction, under conditions of normal respiration.

Abdomen girth (umbilical level). Trunk circumference during normal posture at the level of the umbilicus. In instances of umbilical protrusion, the measurement was taken immediately above the umbilicus.

Upper limb length (acromion to dactylion). Greatest distance, on the left side, from the posterior end of the lateral border of the acromion to the distal tip of the middle finger.

Arm girth (level of deltoid insertion). Maximum circumference of the left arm in the region approximately half way between the acromion and olecranon processes.

Lower limb length (infraischia-soles distance). Stature minus stem length, i.e., the maximum vertical distance from the most inferior level of the ischia to the plantar surface of the feet.

Leg girth (calf circumference). Maximum girth of the left leg in the region of the calf.

Body weight (unclothed). Weight with the subject standing in the middle of the platform on beam-type scales and wearing only cotton shorts or rayon panties.

The measurements were taken with exceptional care, and every child was fully measured by two different anthropometrists.[3] In instances where the results obtained by the two anthropometrists were not in close agreement, each took an additional reading. Consequently the ultimate record was based in some cases on two determinations and in other cases on four determinations. The "close agreement" criteria were derived from earlier investigations of reliability (4, 5, 7). Specifically, the two initial values were required to agree within 0.2 kg. for weight, 0.1 cm. for hip width and leg girth, 0.2 cm. for stature and arm girth, and 0.4 cm. for the other dimensions. This degree of collection precision was adopted in order to reduce the errors of measurement to negligible amounts and thereby procure final values of high morphologic validity.

DATA

The anthropometric data subjected to analysis consisted of 11 measures of body size and 5 measures of body form for each of the 941 subjects. The 11 size traits have been identified in the foregoing section. It remains to specify the 5 traits of body shape or form. These were derived by calculating ratios from selected pairs of dimensions.

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[3] The writers were assisted by nine especially trained persons: helping with the boys' examinations were Stanley Culp, Robert Kane, Everett Peery, Chaley Samples, Paul Sherbina, and Peter Trim; assisting with the girls' examinations were Frances Bascom, Lois Gott, and Merle Sigerseth.

The five varieties of ratio data fall meaningfully into two groups. In one group are three ratios which portray variations in the stockiness of major morphologic segments, i.e., describe body form continua of the slender-to-stocky or girth-in-relation-to-length class. Included here are arm girth/upper limb length, leg girth/lower limb length, chest girth/stem length. The two other ratios pertain to shape relationships between superior and inferior aspects of the trunk, i.e., describe variations in the predominance of upper trunk features over lower trunk features. They are shoulder width/hip width and chest girth/abdomen girth. As is customary practice, all of the figures from ratio computation were multiplied by 100 in order to express each quotient as a percentage.

TABLE I

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7 AND 10 YEARS OF AGE FOR ELEVEN MEASURES OF BODY SIZE ON A 1950 SAMPLE OF WHITE PUBLIC SCHOOL BOYS IN WEST-CENTRAL OREGON

				PERCENTILES					
Dimension	*Mean*	*$S.E._M$*	*S.D.*	5	10	30	70	90	95
SEVEN YEARS: *N* = 260									
Stature (cm.)	122.2	.30	4.77	115.3	116.5	119.4	125.1	128.7	130.9
Stem length	67.5	.16	2.50	63.6	64.2	66.1	68.9	70.8	71.9
Shoulder width	26.9	.08	1.21	24.9	25.3	26.3	27.6	28.5	28.9
Hip width	19.3	.06	1.00	17.7	18.1	18.8	19.8	20.7	21.2
Chest girth	58.2	.17	2.74	54.2	55.0	56.8	59.4	61.7	62.8
Abdomen girth	56.2	.20	3.19	51.7	52.4	54.2	57.4	60.0	61.9
Upper limb length	51.6	.16	2.50	47.8	48.5	50.2	52.7	55.1	56.0
Arm girth	18.4	.08	1.34	16.4	16.8	17.5	19.0	20.0	20.6
Lower limb length	54.7	.18	2.84	50.4	50.9	53.0	56.1	58.4	59.4
Leg girth	24.7	.09	1.51	22.4	22.9	23.8	25.3	26.6	27.3
Weight (kg.)	23.9	.19	3.09	19.7	20.3	22.1	25.0	27.4	28.7
TEN YEARS: *N* = 208									
Stature (cm.)	138.8	.37	5.31	129.8	131.7	136.1	141.6	145.5	147.7
Stem length	73.9	.19	2.72	69.6	70.5	72.4	75.4	77.4	78.7
Shoulder width	30.2	.10	1.49	27.9	28.4	29.3	30.9	31.8	32.5
Hip width	21.6	.08	1.15	19.7	20.2	20.9	22.1	23.1	23.5
Chest girth	64.4	.27	3.85	59.2	60.2	62.4	65.6	69.3	70.9
Abdomen girth	62.2	.35	4.97	56.3	57.1	59.3	63.6	68.0	71.2
Upper limb length	59.5	.19	2.80	54.9	56.1	57.8	61.1	62.8	64.2
Arm girth	20.5	.14	2.06	18.0	18.4	19.1	21.2	22.9	24.3
Lower limb length	64.9	.23	3.36	59.2	60.1	63.3	66.6	69.1	70.2
Leg girth	27.8	.14	1.98	24.9	25.4	26.7	28.7	30.5	31.6
Weight (kg.)	32.9	.35	5.02	25.8	27.3	29.7	34.5	39.3	42.5

$S.E._M$ = standard error of the mean.
S.D. = standard deviation.

TABLE 2

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7, 9, AND 11 YEARS OF AGE FOR ELEVEN MEASURES OF BODY SIZE ON A 1951-52 SAMPLE OF WHITE PUBLIC SCHOOL GIRLS IN WEST-CENTRAL OREGON

				PERCENTILES					
Dimension	*Mean*	*S.E.$_M$*	*S.D.*	5	10	30	70	90	95
SEVEN YEARS: *N* = 168									
Stature (cm.)	121.4	.40	5.11	113.0	114.7	118.4	124.4	128.1	129.9
Stem length	67.0	.21	2.69	62.4	63.5	65.5	68.6	70.4	71.3
Shoulder width	27.0	.09	1.25	24.9	25.3	26.4	27.7	28.6	29.0
Hip width	19.3	.10	1.23	17.2	17.8	18.7	19.9	20.9	21.5
Chest girth	58.5	.29	3.76	53.6	54.3	56.3	59.7	63.5	66.1
Abdomen girth	58.1	.44	5.71	51.0	52.2	54.7	59.5	66.7	68.8
Upper limb length	50.9	.19	2.42	46.7	47.7	49.4	52.1	54.1	54.7
Arm girth	18.9	.14	1.83	16.5	16.8	17.7	19.9	21.4	22.3
Lower limb length	54.4	.23	2.97	49.7	50.4	52.8	55.9	58.5	59.8
Leg girth	24.8	.14	1.84	21.8	22.3	23.8	25.9	27.2	27.7
Weight (kg.)	23.7	.29	3.72	18.7	19.5	21.2	25.4	28.5	30.8
NINE YEARS: *N* = 160									
Stature (cm.)	132.7	.46	5.76	123.1	125.2	130.0	135.8	139.4	142.6
Stem length	71.7	.22	2.73	66.9	67.9	70.1	73.3	75.2	75.8
Shoulder width	29.2	.11	1.41	27.0	27.5	28.5	29.9	31.0	31.5
Hip width	21.1	.11	1.33	19.0	19.4	20.3	21.7	22.9	23.4
Chest girth	62.9	.33	4.22	56.5	58.0	60.6	64.7	68.4	70.2
Abdomen girth	62.5	.51	6.44	54.0	55.2	59.0	64.5	71.5	74.6
Upper limb length	56.3	.22	2.73	51.9	52.9	54.9	57.6	59.5	60.9
Arm girth	20.5	.18	2.33	17.5	17.9	19.1	21.8	23.7	24.9
Lower limb length	61.0	.28	3.59	55.1	56.2	59.3	62.5	65.4	66.9
Leg girth	27.1	.17	2.17	23.6	24.2	25.8	28.1	29.8	30.4
Weight (kg.)	29.8	.41	5.17	22.1	23.7	26.8	32.3	36.4	38.9
ELEVEN YEARS: *N* = 145									
Stature (cm.)	144.4	.53	6.30	134.7	136.3	140.5	147.7	152.6	154.9
Stem length	76.4	.28	3.32	70.8	71.7	74.6	78.1	80.7	82.4
Shoulder width	31.6	.13	1.55	29.0	29.4	30.8	32.3	33.5	34.2
Hip width	23.1	.11	1.37	20.6	21.3	22.4	23.7	24.9	25.3
Chest girth	67.5	.42	5.02	59.8	62.2	64.4	69.5	73.8	76.9
Abdomen girth	67.6	.55	6.64	58.2	60.1	63.4	70.4	77.3	80.2
Upper limb length	61.7	.25	3.01	56.6	57.7	60.1	63.3	65.5	66.5
Arm girth	22.3	.20	2.37	18.5	19.1	21.0	23.4	25.7	26.6
Lower limb length	68.0	.31	3.73	62.0	63.1	66.0	69.8	73.2	74.4
Leg girth	29.4	.21	2.47	25.2	26.5	28.1	30.4	32.4	34.1
Weight (kg.)	37.5	.54	6.49	27.6	29.8	33.8	40.3	46.4	49.5

S.E.$_M$ = standard error of the mean.
S.D. = standard deviation.

Findings on Body Size: Oregon, 1950-52

Central tendency and variability findings for the 11 measures of body size are presented in Tables 1 and 2, for boys and girls respectively. If each trait had given distributions representing statistically normal surfaces, the two independent approaches to analysis of variability (column 3 and columns 4 to 9) would have been redundant. Actually, however, almost half of the distributions (those for weight and the four girths) showed positive skewness, with the others (the 4 lengths and 2 breadths) approximating statistical normality.[4]

A full discussion of the contents of Tables 1 and 2 could extend easily over several pages. It appears sufficient aid for use of the tables to illustrate the different kinds of information that the reader may extract:

1. *Mean size at the ages studied.* The average 10-year-old white schoolboy residing in west-central Oregon—as estimated from the 1950 sample under study—has a stature of 138.8 ± 0.4 cm. and shoulder width (biacromial diameter) of 30.2 ± 0.1 cm.

2. *Increase in mean size over the periods studied.* Compared with the average 7-year-old white schoolgirl residing in west-central Oregon, the average 11-year-old schoolgirl is taller by approximately 23 cm. and heavier by about 14 kg.

3. *Comparative mean size of different dimensions.* For the sample of schoolgirls drawn to represent age 9 years, the mean girth of arm is less than the mean girth of leg by 6.6 cm., or 24 per cent.

4. *Sex differences in mean size at age 7 years.* The paired series of means obtained on present-day Oregon children age 7 years show that the boys are larger than the girls in stature and length of upper extremities, while the two sexes are similar in hip width and leg girth.

5. *Variability in size at the ages studied.* Of the sample of boys drawn to represent age 10 years, 10 per cent weighed less than 27.3 kg., 20 per cent between 27.3 and 29.7 kg., 40 per cent between 29.7 and 34.5 kg., 20 per cent between 34.5 and 39.3 kg., and 10 per cent more than 39.3 kg.

6. *Change in variability with age.* The standard deviations for each trait increase with age. On girls, for instance, the progression in stature is from 5.1 cm. at 7 years through 5.8 cm. at 9 years to 6.3 cm. at 11 years. Corresponding sigmas for weight approximate 3.7 kg., 5.2 kg., and 6.5 kg.

7. *Comparative variability of different dimensions.* At all of the ages studied, the scatter is greater for abdomen girth than chest girth, and greater for lower limb length than upper limb length. In terms of the coefficient of variation (standard deviation × 100/mean) variability is least for stem length and greatest for body weight.

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[4] In this connection see reference 6, pp. 50-51.

8. *Sex differences in variability.* The spread of most distributions is greater for girls than for boys. At age 7 the standard deviations obtained on the girls are appreciably larger than those on the boys, except for the two dimensions, shoulder width and upper limb length.

9. *Overlapping of the distributions for different ages.* The trait distributions show varying amounts of overlapping at successive ages. For shoulder width on girls, 95 per cent of the measures lie below 29.0 cm. at 7 years and only 5 per cent below this value at 11 years; in the case of arm girth on girls, 95 per cent of the measures lie below 22.3 cm. at 7 years and over 50 per cent are still below this value at 11 years.

FINDINGS FOR BODY SIZE: COMPARATIVE

It would be possible to compare selected values from Tables 1 and 2 (particularly the means for stature and weight) with corresponding values on literally scores of groups of white children described in the research literature. Comparisons will be made only with a few groups chosen for their special relevance ethnically, secularly, and geographically.

In the initial selection, the aim was to get as near as possible to a comparison in which ancestry and region were controlled and secular period was the predominant variable. A sample drawn in the fall of 1892 from the public schools of Oakland, California, (1) was selected as best fitted for this purpose. The study was one of several promoted around 1890 by Franz

TABLE 3

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED ALMOST 60 YEARS EARLIER IN WEST-CENTRAL CALIFORNIA (1)

	AGE-SEX GROUP				
	G7*	B7	G9	B10	G11
California, 1892					
Number of subjects	155	170	232	227	223
Mean stature (cm.)	115.0	115.9	125.2	130.9	136.2
Mean weight (kg.)	20.2†	21.1	24.8	28.3	30.5
Oregon, 1950-52					
Taller in stature by:	6.4	6.3	7.5	7.9	8.2
Heavier in weight by:	3.5	2.8	5.0	4.6	7.0

* G7 symbolizes girls age 7 years; B7, boys age 7 years; etc.

† The subjects were weighed wearing indoor clothing (without shoes). Deductions of 1.5 kg. have been made to approximate adjustment for weight of clothing.

Boas; it was carried out cooperatively by the University of California and Stanford University.

Compared with the Oregon sample of the present study, the Oakland sample is strikingly similar ethnically, less than 500 miles removed geographically, but separated in time by more than half a century. Table 3 shows that like age-sex means from the two samples differ systematically, the 1950-52 Oregon children being markedly taller and heavier than the 1892 California children. Expressed in English units, the obtained differences are: (*a*) for stature, 2.5 inches at 7 years and more than 3.0 inches at 10 and 11 years,[5] and (*b*) for weight, around 7 pounds at 7 years and 10 to 15 pounds at 10 and 11 years.

TABLE 4

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN WEST-CENTRAL CALIFORNIA (15)

	AGE-SEX GROUP				
	G7*	B7	G9	B10	G11
California, 1937-39					
Number of subjects	254	235	266	285	272
Mean stature (cm.)	121.1	122.1	132.5	138.4	143.9
Mean weight (kg.)	23.6	23.9	29.7	33.0	37.4
Oregon, 1950-52					
Taller in stature by:	0.3	0.1	0.2	0.4	0.5
Heavier in weight by:	0.1	0.0	0.1	—0.1	0.1

* As in Table 3.

Selections next were made with the objective of aligning findings on the children of the present study with findings on other children as comparable as have been studied ethnically, secularly, and geographically. Highly comparable investigations do not exist; while samples are accessible that essentially match the Oregon sample from the standpoint of ethnic composition, the closest materials geographically and secularly fall in California and Utah during the quinquennium 1934-39.

The California data are part of a large-scale 1937-39 investigation sponsored by the U.S. Bureau of Home Economics (15). They were amassed largely in Alameda and Contra Costa counties (the county in which Oakland is located and one adjacent) and sampled "the general run of white American-born boys and girls in public and private schools, on playgrounds, in camps, and in clubs" (15, p. 2). Means for stature and weight based upon these data are displayed in Table 4. It will be seen that the mean values from sample "west-central California, 1937-39" almost coincide with those from sample "west-central Oregon, 1950-52"; none of the differences is statistically significant.

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[5] An earlier alignment of Toronto school children for the years 1892 and 1939 (12) gave stature differences of practically the same magnitude. For further information on secular change at the elementary school ages, see reference 8, and compare the California means in Tables 3 and 4.

TABLE 5

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1934-39 IN NORTH-CENTRAL UTAH (2, 15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Utah, 1934-39					
Number of subjects	746	740	996	1052	1012
Mean stature (cm.)	120.6	121.5	131.2	137.0	142.3
Mean weight (kg.)	21.2*	22.1	26.2	29.7	32.7
Oregon, 1950-52					
Taller in stature by:	0.8	0.7	1.5	1.8	2.1
Heavier in weight by:	2.5	1.8	3.6	3.2	4.8

* In one of the pooled studies (2) weight was determined in indoor clothing; reductions for estimated clothing weight were made.

Turning to Utah, there are studies which analyze data collected during 1934-35 (2) and 1937-39 (15) in the north-central section. The earlier materials are on white children attending public schools in Logan, Provo, and Salt Lake City; the later materials on white children residing mainly in Cache and Salt Lake counties (the counties in which Logan and Salt Lake City are located). Both samples are ethnically similar to the Oregon sample in that over 90 per cent of the subjects were descendants of immigrants from the British Isles, Netherlands, Scandinavia, and Germany, while approximately 50 per cent were of British ancestry. Table 5 presents statistics from combining the two samples and subtracting the derived stature and weight means from the means of Tables 1 and 2. All of the differences are consistent in direction, and all except those for stature at age 7 years are significant statistically. At ages 9, 10, and 11 years the obtained differences show the 1950-52 children of west-central Oregon to surpass the 1934-39 children of north-central Utah by more than 0.5 inch in stature, and 7 to 10 pounds in weight.

A third comparative goal was that of placing in juxtaposition the children of the present study and other groups of children as similar as have been reported upon ethnically and secularly, but living in diversified regions of North America far distant from Oregon. Looking to the south, to the east, and to the north, selections most suited to this purpose were made in Texas, Maryland and Virginia, and Minnesota.

For Texas, stature and weight materials gathered 1929-31 (19) and 1937-39 (15) were pooled. The earlier sample was obtained in the public schools of San Antonio; it included the run of white children except for a few having "Hebrew, Italian, Greek, Russian, and Syrian" ancestors. The later sample, drawn largely in Bexar, Harris, and Lubbock counties (the counties including San Antonio, Houston, and Lubbock respectively), was part of the previously described survey of American-born white children made by the U.S. Bureau of Home Economics. Composite means from the two studies, together with a listing of the differences between these means and those of Tables 1 and 2, are shown in Table 6. The differences, although statistically significant throughout, are especially marked at ages 9 to 11 years. Stated in terms of the English system of measures, the 1950-52 Oregon children are larger than the 1929-39 Texas children, for stature, by about 0.5 inch at 7 years and more than 1.0 inch after 9 years and, for weight, by around 2 lbs. at 7 years and 5 to 8 lbs. after 9 years.

TABLE 6

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1929-39 IN TEXAS (15, 19)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Texas, 1929-39					
Number of subjects	536	491	724	757	695
Mean stature (cm.)	119.9	121.2	130.3	136.1	141.5
Mean weight (kg.)	22.4	23.2	27.2	30.5	33.8
Oregon, 1950-52					
Taller in stature by:	1.5	1.0	2.4	2.7	2.9
Heavier in weight by:	1.3	0.7	2.6	2.4	3.7

Stature and weight means on white children residing near the eastern seaboard, and studied as recently as 1937-40, were accessible from investigations made in Maryland (20, 21) and in Maryland, District of Columbia, and Virginia (15). In the former, the data were from annual school surveys over the period 1937-40 conducted at Hagerstown by the U.S. Public Health Service. The latter comprises material from another portion of the 1937-39 survey (covering 16 States and the District of Columbia) directed by the U.S. Bureau of Home Economics. Reference to Table 7 indicates that the combined means derived from these samples are below corresponding means from the Oregon sample by appreciable amounts. Conversion of the differences to English units gives comparative values indicating that the children of Maryland and Virginia are: (*a*) shorter by approximately 0.8 inch at 7 years and 1.5 inches at 10 and 11 years, and (*b*) lighter by roughly 4 to 5 lbs. at 7 years and 7 to 10 lbs. at 10 and 11 years.

TABLE 7

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-40 IN MARYLAND, DISTRICT OF COLUMBIA, AND VIRGINIA (15, 20, 21)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Maryland, et al., 1937-40					
Number of subjects	1225	1189	1515	1618	1519
Mean stature (cm.)	119.2	120.1	129.6	135.3	140.5
Mean weight (kg.)	21.2*	21.9	26.0	29.5	32.6
Oregon, 1950-52					
Taller in stature by:	2.2	2.1	3.1	3.5	3.9
Heavier in weight by:	2.5	2.0	3.8	3.4	4.9

* As in Table 5, but substituting (20, 21) for (2).

The 1937-39 accumulation of data by the U.S. Bureau of Home Economics (15) included a northern sample of white children. This sample was drawn in Minnesota, primarily from the adjacent counties of Hennepin and Ramsey (the counties in which Minneapolis and St. Paul are situated). Table 8 depicts stature and weight means on these 1937-39 Minnesota children and itemizes the extent to which they vary from comparable means on the 1950-52 Oregon children. Explicitly the latter are (*a*) taller by 0.8 inch at 7 years and about 1.0 inch at 10 and 11 years, and (*b*) heavier by 2 to 3 lbs. at 7 years and 4 to 7 lbs. at 10 and 11 years.

Ethnic and secular grounds make it pertinent to reach beyond North America for a further stature and weight comparison. The 1950-52 Oregon sample contains a large representation of children whose ancestors resided in the British Isles. In 1948 a survey was carried out on "about seventeen thousand" English children attending schools "situated in widely scattered

Table 8

COMPARISON OF THE STATURE AND WEIGHT MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN MINNESOTA (15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Minnesota, 1937-39					
Number of subjects	577	561	646	652	642
Mean stature (cm.)	119.1	120.1	130.8	136.4	141.3
Mean weight (kg.)	22.1	22.7	27.6	30.8	34.2
Oregon, 1950-52					
Taller in stature by:	2.3	2.1	1.9	2.4	3.1
Heavier in weight by:	1.6	1.2	2.2	2.1	3.3

parts of England" (17). The published tabular results parallel those of the present study (Tables 1 and 2) in that 10th and 90th percentiles are included. In the case of stature, these percentiles are higher for the school children of west-central Oregon than for the English school children by an average of 3.2 cm. (1.3 inches) at 7 years and an average of 4.2 cm. (1.7 inches) at 10 and 11 years. The differences between the 10th percentiles for stature are of approximately the same magnitude as the differences between the 90th percentiles. That this does not hold for weight is seen from the following: the differences between the 10th percentiles average 0.8 kg. at 7 years and 2.9 kg. at 10 and 11 years, while the differences between the 90th percentiles average 3.5 kg. at 7 years and 6.1 kg. at 10 and 11 years. Composite differences for both percentiles show the children in England to be lighter than the Oregon children by 2.2 kg. (4.9 lbs.) at 7 years and 4.5 kg. (9.9 lbs.) at 10 and 11 years.

In addition to statistics for stature and weight, means for arm girth and leg girth are available on the 1937-39 samples of white children studied by the U.S. Bureau of Home Economics in California; Utah; District of Columbia, Maryland and Virginia; Texas; and Minnesota (15). The anthropometric methods employed in determining both girths approximated those used in the present study except that the measurements were taken on the right extremities.

Examination of the successive columns of Table 9 shows that in every instance the mean for Oregon children is higher than the five comparable 1937-39 means. Considering each row of the table as a whole, the Oregon sample differs most from the sample for north-central Utah and least from that for west-central California. For arm circumference, the Oregon children are larger than the Utah and California children by overall averages of 1.5 cm. and 0.7 cm., respectively. The three remaining series of arm figures fall below the Oregon series by average amounts approximating 1.3 cm. (0.5 inch) in each case. For leg circumference, the Oregon and California means are almost alike, while the Oregon means exceed the Utah means by an average of 1.3 cm. Other average differences depict calf girth as comparatively greater on the Oregon children by 1.1 cm. (Minnesota), 0.9 cm. (Maryland, et al.), and 0.8 cm. (Texas).

TABLE 9

COMPARISON OF ARM GIRTH AND LEG GIRTH MEANS FROM TABLES 1 & 2 WITH MEANS FOR WHITE CHILDREN STUDIED 1937-39 IN UTAH, TEXAS, MARYLAND AND VICINITY, MINNESOTA, AND CALIFORNIA (15)

	AGE-SEX GROUP				
	G7	B7	G9	B10	G11
Arm girth (cm.)					
Utah*	17.4	17.6	18.5	19.5	19.9
Texas*	17.6	17.7	18.8	19.6	20.3
Maryland, *et al.**	17.8	17.6	18.9	19.5	20.3
Minnesota*	17.6	17.6	19.0	19.4	20.7
California*	18.1	17.8	19.7	20.1	21.5
Oregon†	18.9	18.4	20.5	20.5	22.3
Leg girth (cm.)					
Utah*	23.8	23.7	25.6	26.5	27.4
Minnesota*	23.9	23.7	25.9	26.7	28.1
Maryland, *et al.**	24.3	24.0	26.1	26.7	28.1
Texas*	24.3	24.3	26.0	27.1	28.2
California*	24.7	24.4	26.8	27.6	29.2
Oregon†	24.8	24.7	27.1	27.8	29.4
Number of subjects					
Utah	253	203	349	402	375
Texas	409	382	476	432	492
Maryland, *et al.*	577	466	646	606	647
Minnesota	479	561	558	652	508
California	254	235	266	285	272

* Taken on right limb. † Taken on left limb.

FINDINGS ON BODY FORM

Statistical reduction of the five kinds of data for body shape paralleled reduction of the body size data. Consequently the column sequence of Tables 10 (boys) and 11 (girls) is the same as in Tables 1 and 2.

TABLE 10

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7 AND 10 YEARS OF AGE FOR FIVE MEASURES OF BODY FORM ON A 1950 SAMPLE OF WHITE PUBLIC SCHOOL BOYS IN WEST-CENTRAL OREGON

				PERCENTILES					
Ratio	*Mean*	*S.E.*$_M$	*S.D.*	5	10	30	70	90	95
SEVEN YEARS: *N* = 260									
$\frac{\text{Arm girth} \times 100}{\text{Upper limb length}}$	35.7	.15	2.46	32.0	32.6	34.2	36.8	38.6	40.0
$\frac{\text{Leg girth} \times 100}{\text{Lower limb length}}$	45.1	.18	2.85	40.5	41.5	43.6	46.3	48.7	49.7
$\frac{\text{Chest girth} \times 100}{\text{Stem length}}$	86.4	.22	3.48	81.0	81.7	84.7	88.0	90.7	91.7
$\frac{\text{Shoulder width} \times 100}{\text{Hip width}}$	139.6	.37	5.95	128.9	131.5	136.2	142.9	147.3	149.0
$\frac{\text{Chest girth} \times 100}{\text{Abdomen girth}}$	103.8	.23	3.61	97.6	99.0	102.0	105.7	108.3	109.3
TEN YEARS: *N* = 208									
$\frac{\text{Arm girth} \times 100}{\text{Upper limb length}}$	34.5	.22	3.13	30.1	31.0	32.7	35.7	37.9	40.8
$\frac{\text{Leg girth} \times 100}{\text{Lower limb length}}$	43.0	.21	3.03	38.9	39.6	41.2	44.3	46.5	47.9
$\frac{\text{Chest girth} \times 100}{\text{Stem length}}$	87.2	.32	4.54	81.1	82.1	84.9	88.6	93.1	96.1
$\frac{\text{Shoulder width} \times 100}{\text{Hip width}}$	140.2	.45	6.45	130.2	132.0	136.9	143.5	147.8	151.7
$\frac{\text{Chest girth} \times 100}{\text{Abdomen girth}}$	103.8	.26	3.75	97.0	98.9	102.2	105.8	109.1	110.3

Again, different ends are served by epitomizing the dispersion of each distribution in a single mathematical figure (the standard deviation) and by representing dispersion ordinally with selected percentiles. This follows from having found that the ratio distributions are not all comparable for symmetry and kurtosis. To illustrate: the distributions for predominance of shoulder width over hip width are coarsely symmetrical; the distributions for stockiness of the body stem and extremities register positive skewness.[6]

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[6] Tests of skewness made earlier on a sample of boys 15 years of age showed, as here, "the distributions for the upper limb and body stem ratios are skewed significantly to the right" (18, p. 7).

No attempt will be made to discuss Tables 10 and 11 in a comprehensive manner. Rather, findings will be selected with regard to three problems: (*a*) age changes in body form, (*b*) sex differences in body form, and (*c*) description of the body form of individuals.

Age changes in body form. In two previous studies encompassing the childhood years from age 4 to age 8 (11, 13), central tendency graphs for arm girth × 100/upper limb length on age, and leg girth × 100/lower limb length on age, gave "falling curves convex to the abscissa" (11, p. 9). That is, trend lines drawn to ratio means at consecutive annual ages supported "the generalization that during the period from 4 to 8 years of age the extremities of the average boy and girl become less stocky (i.e., more slender) at a gradually diminishing rate" (13, p. 280). The applicable means in Tables 10 and 11 harmonize with, and extend, this generalization. On boys, arm girth is 35.7 per cent of upper limb length at 7 years, and lower at 10 years by 1.2. Corresponding values for leg girth in percentage of lower limb length are 45.1 and 2.1. On girls, the upper limb index declines from 37.3, through 36.6, to 36.2; the lower limb index from 45.8, through 44.4, to 43.4.

In contrast with the ongoing slenderization of the extremities between 4 and 11 years of age, the mean trend for chest girth × 100/stem length is downward during the first half of the period and upward in the last half. The investigations previously cited (11, 13) demonstrated decreasing stem stockiness from 4 to 7 years, while the means in Tables 10 and 11 indicate less stockiness at 7 years than at the older ages. With regard to the rising phase of the curve: (*a*) the boys' means of 86.4 and 87.2 are complemented by a mean of 91.1 on a sample of Oregon boys age 15 years (18, p. 8), and (*b*) the progression in means found for girls is supported by an earlier finding on Iowa girls of a "slightly higher" mean at 8 years than at 7 years (13, p. 278).

A research report on private school children (3) supplies central tendency curves extending from early childhood through adolescence for the index, biacromial width of shoulders × 100/bi-iliocristal width of hips. It is shown that during the elementary school years the index decreases with age in girls and undergoes practically no change in boys. The findings of the present investigation are in general agreement: for boys, shoulder width approximates 140 per cent of hip width at both ages; for girls, the index drops from approximately 140 at 7 years to nearly 137 at 11 years.

The means in Tables 10 and 11 for chest girth × 100/abdomen girth are the same at ages 7 and 9 years on girls, and the same at ages 7 and 10 years on boys. At later ages there are indications that the trends turn in different directions. Specifically, the mean of 100.2 on Oregon girls age 11 is lower than the mean of 101.1 at age 9, and the mean of 105.6 on Oregon boys age 15 (18) is higher than the mean of 103.8 at age 10.

In an investigation at New York City on white boys (16), the pattern of change for chest girth/abdomen girth was studied by graphing means at annual intervals from early childhood through adolescence. This investigation differed methodologically from the Oregon studies in that the numerator used in ratio computation was the midpoint of readings made "at total inspiration and at total expiration" (16, p. 40). A rising index was obtained, the mean at age 10 exceeding that at age 7 by 2.8 per cent and the mean at age 15 exceeding that at age 10 by 2.2 per cent. As noted above, the means for Oregon boys lend no support to increase between 7 and 10 years, but do corroborate an ascending trend in the period 10 to 15 years.

Sex differences in body form. For all of the girth/length ratios in Tables 10 and 11, the average Oregon girl is stockier than the average Oregon boy. On plotting the means at each age, and drawing lines connecting the points for a given sex and ratio, this is found to hold across the age span from 7 years through 10 years. From the previously cited work on Iowa children 4 to 8 years of age, the sex relationships differed somewhat. Consistently, the average girl was the more stocky in upper limb, and the average boy the more stocky in body stem. In lower limb, the average boy was the stockier at ages 4 and 5 years, both sexes were alike at ages 6 and 7 years, and the average girl became "the more stocky by 8 years" (13, p. 280).

Passing to the means for the trunk indices, Tables 10 and 11 show that at 7 years of age the Oregon boys and girls: (*a*) are alike with respect to predominance of shoulder width over hip width, but (*b*) differ in that the predominance of chest girth over abdomen girth is greater for the former by 2.5 per cent. On boys, both ratios at 10 years are approximately the same as at 7 years; on girls, both ratios become lower with age. In other words, for the aspects of trunk form studied, there is no change between 7 and 10 in boys, while girls increase in hip width relative to shoulder width, and in abdomen girth relative to chest girth. The findings on sex relationships for the shoulders/pelvis index reinforce those reported in the aforementioned study of private school children (3).

Girls are more variable than boys in each of the stockiness ratios and in the ratio of chest girth to abdomen girth. More explicitly, for these aspects of body form, the standard deviations on girls are larger than those on boys not only at the age in common for both sexes (7 years) but also without regard to age. That is, the higher standard deviation for the upper limb index on boys (3.13 at 10 years) is less than the lowest on girls (3.43 at 7 years), the higher standard deviation for the lower limb index on boys (3.03) is less than the lowest on girls (3.50), and so forth. For the shoulders /pelvis index, no significant sex difference in variability is found.

Description of the body form of individuals. As a prerequisite to objective description of body form status and progress in individual children,

TABLE II

CENTRAL TENDENCY AND VARIABILITY VALUES AT 7, 9, AND 11 YEARS OF AGE FOR FIVE MEASURES OF BODY FORM ON A 1951-52 SAMPLE OF WHITE PUBLIC SCHOOL GIRLS IN WEST-CENTRAL OREGON

				PERCENTILES					
Ratio	*Mean*	*S.E.*$_M$	*S.D.*	5	10	30	70	90	95
SEVEN YEARS: *N* = 168									
Arm girth × 100 / Upper limb length	37.3	.27	3.43	32.3	33.1	35.3	39.0	41.7	42.8
Leg girth × 100 / Lower limb length	45.8	.27	3.50	40.1	40.9	43.9	47.6	50.0	51.5
Chest girth × 100 / Stem length	87.4	.41	5.25	79.8	81.0	84.5	89.3	93.2	98.7
Shoulder width × 100 / Hip width	139.8	.45	5.79	131.2	132.6	136.4	142.7	147.4	149.8
Chest girth × 100 / Abdomen girth	101.2	.38	4.93	91.6	94.7	98.9	103.9	107.5	108.6
NINE YEARS: *N* = 160									
Arm girth × 100 / Upper limb length	36.6	.30	3.78	31.4	32.2	34.2	38.1	41.8	43.5
Leg girth × 100 / Lower limb length	44.4	.28	3.55	39.1	40.1	42.4	46.3	48.8	50.7
Chest girth × 100 / Stem length	87.8	.37	4.71	80.7	82.3	85.3	90.1	94.5	96.5
Shoulder width × 100 / Hip width	139.0	.54	6.78	129.2	131.0	135.1	142.6	148.4	150.3
Chest girth × 100 / Abdomen girth	101.1	.40	5.01	91.9	94.0	98.8	103.8	107.0	108.9
ELEVEN YEARS: *N* = 145									
Arm girth × 100 / Upper limb length	36.2	.31	3.71	30.7	31.6	34.1	38.0	41.2	42.5
Leg girth × 100 / Lower limb length	43.4	.31	3.68	37.5	39.0	41.4	44.9	47.8	50.5
Chest girth × 100 / Stem length	88.3	.48	5.81	80.2	82.1	84.8	90.5	97.1	100.1
Shoulder width × 100 / Hip width	137.4	.56	6.73	126.1	129.4	133.3	141.3	145.7	147.3
Chest girth × 100 / Abdomen girth	100.2	.41	4.93	91.4	93.4	97.8	103.0	105.9	107.6

there is need for the development of metrically-based frames of reference.[7] Beginning work on this task has been included in previous studies on Iowa children 4 to 8 years of age (11, 13) and Oregon boys 15 years of age (18).

Since it is desirable to reduce the number of items in an anthropometric frame of reference to the minimum for adequacy, information on the intercorrelation of items proposed for inclusion is a matter of antecedent concern. To what extent, then, do the five indices of the present study each supply unique knowledge about the body form of the child? Investigation of this question (10, 11, 13, 18) has yielded: (*a*) at ages 4 through 8, 10, and 15 years, coefficients ranging from .29 to .68 for the upper limb index with the stem index, from .26 to .58 for the lower limb index with the stem index, and from .65 to .85 for the lower limb index with the upper limb index; (*b*) at ages 7, 10, and 15 years, coefficients varying between .18 and .37 for the shoulders/pelvis index with the chest/abdomen index; and (*c*) at age 15 years, coefficients that approximate zero for the shoulders/pelvis index with each of the stockiness indices, and are low negative for the chest/abdomen index with each of the stockiness indices. It will be seen that the associations are highest between the upper and lower limb indices; the characterizing figure of $r = .75$, however, is not sufficiently high that an index for one limb of the child can be considered adequate to represent stockiness in both pairs of appendages.

The percentile columns of Tables 10 and 11 serve to section each continuum into seven segments. The segment below the 5th percentile is regarded as constituting one category, that between the 5th and 10th percentiles as constituting a second category, and so forth. It follows that the seven categories afford a practical means of objectively describing individuals with respect to each item of body form included in the tables.[8]

Application of the tables to individual children is illustrated by the following examples. A boy 7 years of age is found to have index values of 31.0 for the upper limb, 42.5 for the lower limb, 86.8 for the body stem, 139.2 for shoulders/pelvis, and 108.9 for chest/abdomen. Reference to Table 10 shows that his profile is 1-3-4-4-6, i.e., described in terms of the "7-year frame" derived from present-day public school boys of west-central Oregon, he has very slender upper limbs, moderately slender lower limbs, average body stem and chest/abdomen configurations, and a marked predominance of width of shoulders over width of hips. Listed in the same order, values for a girl 9 years of age are 42.7, 45.0, 92.3, 128.1, and 101.6. The category equivalents for these values are 6-4-5-1-4, i.e., Table 11 depicts this girl as having stocky upper limbs, average lower limbs, a moderately stocky body stem, very narrow shoulders relative to pelvis, and an average relationship between circumference of thorax and circumference of abdomen.

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[7] In this connection see reference 11, p. 3.

[8] The five ratios of this study must be complemented with additional ratios before a reasonably comprehensive frame of reference on body form will have been constructed. Aspects of form that probably should be added include head width in relation to head length, face width in relation to face height, chest depth in relation to chest width, and stem length in relation to length of the extremities.

SUMMARY

White public school children of west-central Oregon are portrayed with reference to 11 measures of body size and 5 measures of body form. The data were collected 1950-52 on samples drawn to represent boys 7 and 10 years of age, and girls 7, 9, and 11 years of age.

Following description of the subjects and specification of the collection procedures, central tendency and variability analyses are presented on each age-sex group for body weight, stature, stem length, and four dimensions each of the trunk and extremities.

A comparative section on body size places in juxtaposition the Oregon children and other groups of white children chosen to approximate stated ethnic, secular, and geographic permutations. Materials are utilized from west-central California, north-central Utah, Minnesota, Texas, Maryland and Virginia, and England.

The aspects of body form fall into two classes, slender-to-stocky continua (length of stem and limbs in relation to girth) and regional-predominance continua (relations between upper trunk and lower trunk). After presentation of central tendency and variability values for form, these original statistics and statistics from the literature are conjoined in the discussion of three topics: age changes in body form, sex differences in body form, and delineation of the body form of individuals.

REFERENCES

1. BOAS, F. The Growth of first-born children. *Science,* 1895, n.s. 1, 402-404. (See also E. Barnes, Physical development of Oakland children. *Ann. Rep. Pub. Sch. City of Oakland,* 1892-93, pp. 38-44.)
2. BROWN, ALMEDA P. *Comparative size of rural and urban Utah school children as determined by the weight-height-age relationship.* Utah Agric. Exp. Station Bull., 1936, No. 266.
3. GRAY, H., and AYRES, J. G. *Growth in private school children.* Chicago: Univ. Chicago Press, 1931.
4. KNOTT, VIRGINIA B. Physical measurement of young children: A study of anthropometric reliabilities for young children three to six years of age. *Univ. Ia. Stud. Child Welf.,* 1941, 18, No. 3.
5. MARSHALL, E. L. The objectivity of anthropometric reliabilities taken on eight- and nine-year-old white males. *Child Develpm.,* 1937, 8, 249-256.
6. MEREDITH, H. V. The rhythm of physical growth: A study of eighteen anthropometric measurements on Iowa City white males. *Univ. Ia. Stud. Child Welf.,* 1935, 11, No. 3.

7. Meredith, H. V. The reliability of anthropometric measurements taken on eight- and nine-year-old white males. *Child Develpm.*, 1936, 7, 262-272.
8. Meredith, H. V. Stature and weight of children of the United States, with reference to the influence of racial, regional, socioeconomic and secular factors. *Amer. J. Dis. Child.*, 1941, 62, 909-932.
9. Meredith, H. V. Relation between socioeconomic status and body size in boys seven to ten years of age. *Amer. J. Dis. Child.*, 1951, 82, 702-709.
10. Meredith, H. V. Size and form of boys of U.S.A.-North European ancestry born and reared in Oregon. *Growth*, 1951, 15, 39-55.
11. Meredith, H. V., and Culp, S. S. Body form in childhood: Ratios quantitatively describing four slender-to-stocky continua on boys four to eight years of age. *Child Develpm.*, 1951, 22, 3-14.
12. Meredith, H. V., and Meredith, E. Matilda. The stature of Toronto children half a century ago and today. *Hum. Biol.*, 1944, 16, 126-131. (See also N. Keyfitz. *A height and weight survey of Toronto elementary school children, 1939*. Ottawa: Dept. of Trade and Commerce, Dominion Bur. Statistics, 1942.)
13. Meredith, H .V., and Sherbina, P. R. Body form in childhood: Ratios quantitatively describing three slender-to-stocky continua on girls four to eight years of age. *Child Develpm.*, 1951, 22, 275-283.
14. Newcomer, E. O., and Meredith, H. V. Eleven measures of body size on a 1950 sample of 15-year-old white schoolboys at Eugene, Oregon. *Hum. Biol.*, 1951, 23, 24-40.
15. O'Brien, Ruth, Girshick, M. A., and Hunt, Eleanor P. *Body measurements of American boys and girls for garment and pattern construction.* Bur. Home Econ., U.S. Dept. Agric. Misc. Pub., 1941, No. 366.
16. Schwartz, L., Britten, R. H., and Thompson, L. R. *Studies in physical development and posture. U.S. Publ. Hlth. Bull.*, 1928. No. 179.
17. Sutcliffe, A., and Canham, J. W. *The heights and weights of boys and girls.* London: John Murray, 1950.
18. Trim, P. T., and Meredith, H. V. Body form in *Homo sapiens*: A study of five anthropometric ratios on white boys fifteen years of age. *Growth*, 1952, 16, 1-14.
19. Whitacre, Jessie. *Some body measurements of Texas school children.* Texas Agric. Exp. Station Bull., 1939, No. 567.
20. Wolff, G. Further results on the trend of weight in white school children. *Child Develpm.*, 1941, 12, 183-205.
21. Wolff, G. A study of height in white school children from 1937 to 1940 and a comparison of different height-weight indices. *Child Develpm.*, 1942, 13, 65-77.

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GROWTH AND DEVELOPMENT OF NEGRO INFANTS: IV. MOTOR DEVELOPMENT AND ITS RELATIONSHIP TO CHILD REARING PRACTICES IN TWO GROUPS OF NEGRO INFANTS[1]

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PROBLEM

In an effort to clarify some of the misconceptions about racial differences, a comparative study of a group of white and Negro infants was conducted in New Haven a number of years ago (5). On the basis of performance on the Gesell Developmental Schedules, the average New Haven Negro infant was found to be "fully equal in behavioral development to the average New Haven white baby. . . . No outstanding characteristic was found which could be called a 'racial' difference, with the possible exception of a definite acceleration in gross motor behavior displayed by the Negroes" (5, p. 42). This latter aspect of the New Haven findings, namely, the acceleration of gross motor behavior among Negro infants, is the main concern of the present investigation.

It is postulated that early motor development, accelerated or otherwise, is not a "racial" characteristic but, instead, is related to the manner in which an infant is handled and cared for. As child rearing practices have been shown to vary with socio-economic class (1, 2, 3), the subjects for this study, although all Negroes, were selected from two sharply contrasting socio-economic backgrounds.

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[1] The authors wish to express their indebtedness to a number of people for their invaluable contributions to the study: Dr. Benjamin Pasamanick of the Johns Hopkins School of Hygiene not only acted as consultant throughout the conduct of the study but also, together with Dr. Hilde Knobloch, did the independent scoring of the Gesell Schedules; Dr. George Albee is responsible for most of the statistical work; Dr. Melvin Jenkins, Dr. Blanche Bourne, and Dr. Althea Kessler provided subjects from private practice; Dr. Ella Oppenheimer, Director of the Bureau of Maternal and Child Welfare, and Dr. Grace Stone made the facilities of the Maternal and Child Welfare Service available; Dr. Leon Yarrow made many helpful suggestions during the conduct of the study. Dr. Milton J. E. Senn and Dr. Sally A. Provence of the Child Study Center at Yale University read the manuscript and gave helpful suggestions. Dr. F. C. Sumner and Astrea S. Campbell of the Department of Psychology of Howard University also reviewed the manuscript during its preparation for publication. The authors are especially indebted to the Field Foundation, Inc., for financial assistance in this study.

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Specifically, the study was designed to answer the following:

1. Is there a difference in gross motor behavior among Negro infants from an upper and lower socio-economic group?

2. Do the two groups differ in their reported and observed methods of child care?

3. If motor behavior is found to differ significantly for the two groups, can this difference be related to methods of child care?

METHOD

The subjects for the study were 104 Negro babies, ranging in age from 4 to 18 months, all residents of the Washington, D.C., city area.[4]

Of the 104 babies, 54 (Group I) received their medical care from a private pediatrician. The weekly income of the parents in this group was $80.00 or above.

Of the remaining 50 babies (Group II), 36 were selected from the 150 in attendance at the Freedmen's Hospital Well Baby Clinic. The other 14 were regular patients at one of the District of Columbia Maternal and Child Welfare Service Clinics. The weekly income of the parents of this group was $45.00 or below. The subjects were approximately evenly divided as to sex: there were 26 males and 28 females in Group I; 24 males and 26 females in Group II. (Additional descriptive data about the subjects and their families are given later on.)

All the babies in Group I and the 36 babies from the Freedmen's Well Baby Clinic were first seen at Freedmen's Hospital, in a small but quiet room set aside for the purpose. For Group I, the initial contact was made by the private pediatrician, who briefly explained the project and what it would involve to the mother, and made an appointment. The 36 subjects from Freedman's Hospital were similarly approached by the examiner during regular clinic hours and an appointment was made at the mother's convenience. The 14 babies from the Welfare Service clinic were seen during regular clinic hours at the Health Department Clinic building. The physician in charge explained the procedure, introduced the examiner, and mother and child were then conducted to a room apart from the regular clinic examination rooms. All 14 babies were seen before they went through the routine experience of clinic itself.

In all cases the first session was begun with a short preliminary interview conducted with the adult who brought the baby, in most cases the mother, occasionally both parents. A few of the working mothers who could not arrange to come themselves sent the baby with the regular mother-substitute. The interview followed, in general, the one outlined by Gesell and Amatruda in *Developmental Diagnosis* (4, p. 91) and covered the baby's motor and language development, play, domestic and emotional behavior. An attempt was made to keep the interview less directive than suggested by Gesell.

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[4] Washington city excludes bordering areas of Maryland and Virginia.

In addition, information was secured as to the economic background of the family, the age, education, occupation and geographic origin of the parents, the housing of the family, the number and age of the subject's siblings. The examination itself was then conducted. It was limited to the gross motor items on the Gesell Developmental Schedules. The few materials necessary for the administration of these items were available both at Freedmen's Hospital as well as at the Health Department Clinic—the crib, small chair, the balls, and the introductory toy, usually given to the baby while the interview was in progress and used again, if necessary, to induce such items as pivoting, cruising, etc. The performance was recorded on the regular schedule form during or immediately after the examination. Observational notes on the baby's behavior and on the interaction between adult and child were also made, but, because of time limitations, were in most instances rather brief.

Of the 104 babies, 91 were seen again from three to six months after the initial contact. At this time the babies were visited in their homes.[5] The visit lasted for approximately one hour and was devoted to observation of the subject in interaction with the mother or mother-substitute and a detailed interview which covered the following areas: prenatal care and health of the mother; postnatal condition, care, and health of mother and child; feeding and weaning of the child and the mother's attitudes toward these; toilet training; sleeping habits and discipline. There were a number of questions included which related to general attitudes ("Is the baby a lot of trouble?" "What do you do if the baby cries?" etc.). The body of the interview was devoted to various aspects of dealing with and handling the baby which were felt to have a direct bearing on motor development: the amount of restriction and/or freedom of movement the baby has; means by which he is restrained; the extent and kind of contact he is permitted with other persons or objects; the amount and kind of encouragement given to the various motor functions; kinds of games played with the baby and amount of time spent in play; ways in which the baby is moved and carried. An effort was made to interview the person who most consistently cared for the child. In a few instances the mother insisted on being seen even though her contact with the child was minimal. The mother was interviewed whenever a number of people shared in the care of the child and when no one person was consistently responsible. Whenever two people

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[5] Fifty-one of the babies in Group I were seen a second time. Of the three in this group who were not seen again, one had moved out of town and the other two could not be reached by phone, mail, or direct visit and did not return to their pediatrician. Of the 10 babies in Group II who could not be contacted, one was given up for adoption out of town, one was boarded with an aunt who consistently refused to see the examiner, three are definitely known to have moved, and the remaining five could not be located at their last address and never returned to clinic.

TABLE I

YEARS OF EDUCATION OF PARENTS IN GROUPS I AND II

No. of Years	Group I Mothers $N=54$	Group I Fathers $N=54$	Group II Mothers $N=50$	Group II Fathers $N=50$
19 or more	—	6	—	—
17 — 18	5	5	—	—
15 — 16	16	9	—	1
13 — 14	13	12	2	—
11 — 12	19	17	23	21
9 — 10	1	3	11	7
7 — 8	—	2	9	5
5 — 6	—	—	3	2
3 — 4	—	—	2	—
Unknown	—	—	—	14

participated equally, an attempt was made to elicit whatever conflict existed in respect to the care and attitudes toward the baby. The interview was, as much as possible, kept loosely structured. Topics of discussion were suggested in the broadest terms and the interviewee was encouraged to talk freely and at length. However, there were some cases in which a great deal of prodding was necessary to secure information and in which questions had to be phrased with increasing directness. A rating of the home, including an evaluation of the neighborhood, the condition of the dwelling unit itself, and the adequacy of space and furnishings, was also made at the time of the visit.

The subjects. Before the results of the study are presented, it is necessary to give further descriptive data about the subjects and their families. As the study is primarily a comparative investigation of motor development among Negro infants of contrasting socio-economic backgrounds, it is important to establish that these backgrounds are truly different and stand in contrast to each other. The initial selection of subjects was made on the basis of family income and the kind of medical care the baby was receiving—namely, that of a private pediatrician or a free clinic. Income is a fairly objective criterion of economic level; the kind of medical care a family has is not only a reflection of the former but also a clue as to the family's "self-concept of status."[6] The data presented below show that, in addition to these two factors, sharp differences exist between the two groups as to housing and the parents' educational and occupational levels.

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[6] The pediatricians from whose practice the subjects in Group I were drawn are all on the staff of a university hospital as well as a medical school and have a great deal of professional status and prestige.

According to the preliminary 1950 census figures for Washington city (8), 21 per cent of the Negro population in the area has an income of $4,000 or above. Of the 54 subjects in Group I, 13 are in the $4,000 to $4,500 range. The rest are in the above $5,000 income bracket, or the uppermost 13 per cent of the Negro population in Washington city. With the exception of six families who make approximately $2,300 a year, the families in Group II fall below the $2,000 a year income limit, or within the lowest 31 per cent of the Negro population of Washington city.

Table I gives the educational level of the parents in the two groups. While most of the parents in Group I have an educational level of high school or above, those in Group II have one of high school or below. The mean educational level is 13.9 years and 14.0 years for the mothers and fathers of Group I respectively; the mothers of Group II have a mean of 9.8 years of education while the 36 fathers of that group whose educational background is known have a mean of 10.5 years.

TABLE 2

OCCUPATIONS OF PARENTS IN GROUPS I AND II

	Group I		Group II	
	Mothers $N=54$	*Fathers* $N=54$	*Mothers* $N=50$	*Fathers* $N=50$
Professional*	17	11	—	—
Professional Athlete	—	1	—	—
Business†	—	7	—	—
Clerical	31	24	5	4
Sales	3	—	1	—
Skilled Trades	—	11	—	2
Unskilled Labor	—	—	6	28
Domestic Work	—	—	27	2
Unemployed‡	—	—	—	2
None§	3	—	11	—
Student	—	—	—	1
Armed Forces	—	—	—	6
Unknown	—	—	—	5

* Includes 8 nurses.

† Includes 3 who own taxicabs.

‡ When employed, worked as unskilled laborer.

§ Never worked.

TABLE 3

BIRTHPLACE AND YEARS OF RESIDENCE IN WASHINGTON, D.C., OF PARENTS IN GROUPS I AND II

	Group I		Group II	
	Mothers $N=54$	*Fathers* $N=54$	*Mothers* $N=50$	*Fathers* $N=50$
Born in D.C.	20	18	15	14
Born in South	24	33	33	33
Born Elsewhere	10	3	2	2
Birthplace Unknown	—	—	—	1
D.C. since 1940 or Earlier	28	27	22	25

As shown in Table 2, there is only a slight overlap in terms of occupations for the parents in the two groups. While the bulk of mothers and fathers in Group I hold professional or clerical positions, none of the parents in Group II are in the former category and only five mothers and four fathers are in the latter. There may also be some differences as to the level of clerical work for the two groups, although this information was not obtained. Most of the mothers in Group II are or were in domestic work, while most of the fathers are unskilled laborers.

Table 3 deals with the information relating to the parents' place of birth and length of residence in Washington, D.C.

Table 4 summarizes the housing conditions for the two groups. Only the 91 homes which were visited by the examiner are included in the table. Each home was rated on a three point scale (excellent, adequate, inferior), and such factors as neighborhood, conditions of the dwelling unit, adequacy of space, were taken into account when the rating was made. In the excellent category are not only private homes but also the better of the housing projects, apartments of adequate size with all necessary facilities such as

TABLE 4

HOUSING CONDITIONS OF SUBJECTS IN GROUPS I AND II

Rating	*Group I*	*Group II*
Excellent	43	4
Adequate	8	22
Inferior	—	14

heat, light, and plumbing. Most of the inferior homes were slum dwellings, usually one room units in dilapidated areas and buildings. The houses rated as adequate fall in the hard to define and describe in-between range, usually comprise apartments in old buildings, shared and somewhat crowded homes, or older and slightly deteriorated projects. The housing conditions for Group I are most often excellent, while the bulk of Group II live in homes rated adequate or inferior.

As part of the socio-economic evaluation of the families, it should be mentioned that none of the 54 babies in Group I are illegitimate and that none of the parents in that Group were either separated or divorced at the time the babies were seen. Six of the 50 babies in Group II are definitely known to be illegitimate. In four additional cases the parents were not living together at the time the babies were seen and the mothers were evasive when questioned about their exact marital status. The clinic record for two of these four describes their status as illegitimate; for the two other cases no additional information could be found in the record.

The following data pertains to the infants themselves. Table 5 gives the age distributions for the two groups. The mean age for Group I is 41 weeks, for Group II 38 weeks. These ages refer to the time of the first examination.

Table 5

AGE DISTRIBUTIONS FOR GROUPS I AND II

Age	*Group I* *N*=54	*Group II* *N*=50
18 months	2	3
16 — 17 months	6	1
14 — 15 months	6	3
51 — 56 weeks	3	3
45 — 50 weeks	7	6
39 — 44 weeks	4	6
33 — 38 weeks	5	8
27 — 32 weeks	6	9
21 — 26 weeks	8	4
— 20 weeks	7	7

Insufficient growth data is available to report and compare growth progress and patterns for the two groups. However, a comparison of birth weights, available for all infants, show considerable difference for the two groups, the mean for Group I being 7.46 pounds (3387 grams) and for Group II, 7.0 pounds (3178 grams). The birth weight range for Group I was 5 pounds 14 ounces to 9 pounds 9 ounces; for Group II the range was 5 pounds 3½ ounces to 9 pounds 1 ounce.[7]

No record of degree of pigmentation was kept for the subjects. Babies in both groups ranged from dark brown to very light, with those in Group I somewhat lighter, on the whole, than those in Group II.

There is no essential difference as to the number of siblings in the two groups. Thirty-nine of the 54 babies in Group I are only children, 9 have one older sibling, 3 have two older siblings, one has three older siblings, and 2 have one younger sibling. In Group II, 35 of the 50 babies are only children, 7 have one older sibling, 7 have two older siblings, and one has three older siblings.

The health records for the two groups were examined and additional information on health histories was secured from the mothers and, if necessary, from the physicians. Only full-term, healthy babies were included in the study. For Group I, the following illnesses were reported prior to the time the babies were first seen: 7 cases of diarrhea; 1 case each of measles, chicken-pox, colic; 1 naval hernia; 1 case of pyloric stenosis for which an operation was performed at the age of two weeks. This infant was hospitalized for four or five days and when seen for his developmental examination, was 21 weeks old. In Group II there were 8 cases of diarrhea; 1 hernia which required a week's hospitalization at the age of one year (the child was seen when 18 months old); 2 cases of slight eczema; 1 virus infection with temperature. Common colds were reported for almost all the children in the two groups.

At this point it might be pertinent to describe the rather striking difference in reactions on the part of the parents in the two groups to the entire examination procedure and situation. As already mentioned, the subjects in Group I were contacted by their private physicians. Hardly any of the appointments made were broken. The mothers were eager to have the examination performed and most came with many questions about their child's "intelligence," showed great concern about "retardation," and needed much reassurance about their baby's development. Comments such as "Shouldn't he be walking?", "Does she do as well as other children?", "Do you really think he is all right?" were extremely common. There was embarrassment if the mother thought the child was not "performing" and much pressure was exerted to get him to show his various "tricks."

Among the 36 Freedmen's Hospital Well Baby Clinic subjects, the problem of motivating the mothers to come was a major one. Once the mothers brought their babies for the examination, there was interest, but none of the anxious concern that was so characteristic of Group I mothers. Favorable comments about the baby's development were, of course, accepted with pleasure but also greeted with such remarks as: "Yes, we know she is smart," "Sure he does well," "All my children are quick." Demands for reassurance were rare. The most prevailing reaction in this group of mothers was acceptance of and confidence in the baby and pride in his development. There was little manifestation of pressure on the child, which seemed so pervasive among the parents of Group I.

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[7] For additional data on birth weights among Negroes, see Scott *et al.* (7).

RESULTS

The developmental examinations. The gross motor items on the Gesell Developmental Schedules had been administered to each subject. An estimate of the level of maturity in the gross motor area was made and from this evaluation a Developmental Quotient was computed:

$$\text{D.Q.} = \frac{\text{Maturity Age}}{\text{Chronological Age}} \times 100.$$

The 104 Gesell record forms, without identifying data except name and age, were submitted to two experienced examiners for independent evaluations and scoring. The reliability of the original D.Q.s with those of the first independent examiner was .98, and with those of the second, .99. Both of these coefficients were, of course, significant at the .01 level of confidence. The following data are based on the original scores.

Table 6 lists the mean D.Q.s for Group I (upper socio-economic level) and Group II (lower socio-economic level). The "t" value is significant at about the .02 level of confidence and indicates significantly higher motor development for the babies from the lower socio-economic group.

TABLE 6

GROSS MOTOR D.Q.'s FOR GROUPS I AND II

	Mean D.Q.	*Standard Deviation*	t*
Group I (N=54)	107.57	15.10	2.33
Group II (N=50)	114.32	14.14	

* For 100 degrees of freedom, t must be 2.62 for the .01 level of confidence and 1.98 for the .05 level of confidence.

Each of the two groups was then divided into (*a*) those 37 weeks of age or younger, and (*b*) those 38 weeks or older, in order to ascertain whether the superior motor development of Group II achieved its significance early or late, or whether these infants were ahead consistently, and, finally, whether motor development, regardless of group, shows any consistent trend with age.

Table 7 shows the means of the younger and older subjects of both groups. It will be noted that the babies in the lower socio-economic group appear to be more advanced at both stages of development, although, because of the greater variability of the sample at the younger age level, only the older infants differ significantly in the present comparison. As shown by the increasing means for both groups, motor development seems to accelerate with age.

TABLE 7

MOTOR D.Q.'s FOR GROUPS I AND II FOR TWO AGE LEVELS

	Group I		Group II		
	Mean	*S.D.*	*Mean*	*S.D.*	*t**
Younger	103.92	15.00	110.74	16.55	1.54
Older	111.00	14.04	118.52	9.16	2.26

* A *t* value of 2.00 is required for significance at the .05 level of confidence.

To sum up this portion of the results, the infants of Group II show significant acceleration of gross motor behavior when compared to those of Group I. These differences appear to hold in both younger and older groups of infants, although the variability in the younger group obscures this difference.

The interview. Fifteen separate categories expressing different child care practices were devised to make the previously described interview material more objective. All but one of these categories were expressed as dichotomies. The 15 categories are cited below. The first few deal with general child care practices which in other studies (1, 2, 3) were found to have a relationship to socio-economic class.

1. Duration of breast-feeding (four groupings): not at all, 3 months or less, 4 to 5 months, 6 months or longer.
2. Feeding schedule: rigid—flexible.
3. Inception of bottle-weaning: before 12 months—after 12 months.[8]
4. Food forced against will: yes—no.
5. Inception of toilet training: before 12 months—after 12 months.[8]
6. Sleep routine: rigid—flexible.
7. Discipline: necessary—restrictive.

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[8] Bottle-weaning and toilet-training could not be dealt with in greater detail because of the wide age range of the subjects; in some instances neither weaning nor training had begun and the expected age for their inception had to be probed for.

8. Attitudes on non-approved habits: permissive—punitive.

The remaining seven categories are those dealing with practices felt to have a direct bearing on motor behavior and each requires a word of explanation.

9. Area restriction: yes—no. The concern here was primarily with the extent to which the child is kept in one place and out of others, the amount of freedom he has in moving about the home.

10. Mechanical restriction: necessary—restrictive. This category indicates whether devices such as crib, playpen, baby-tender, or whatever is appropriate at a given age are used with limits and for their intended purpose or whether they serve and are extensively used to insulate the child from his environment.

11. Freedom to experiment: extensive—limited. This category embraces all the interview answers which gave clues to the amount of freedom the child has to exercise his motor functions and experiment with motion.

12. Reaching out: permitted—intimidated. The concern here is with how the child's outgoing motions toward objects and persons are dealt with, whether active interplay is encouraged or discouraged.

TABLE 8

CHILD REARING PRACTICES AND THEIR RELATIONSHIP TO SOCIO-ECONOMIC GROUP

*Rearing Practice**	*Group I* $N=51$ +	—†	*Group II* $N=40$ +	—	*Significance Level*
Feeding Schedule (Rigid +, Flexible —)	37	14	19	21	.03
Bottle Weaning (Before 12 mos. +, After —)	14	37	7	33	—‡
Food Forced (Yes +, No —)	8	43	3	37	—
Toilet Training (Before 12 mos. +, After —)	34	17	23	17	—
Sleep Routine (Rigid +, Flexible —)	45	6	21	19	.01
Discipline (Restrictive +, Necessary —)	25	26	9	31	.019
Habits (Punitive +, Permissive —)	26	25	13	27	—
Area Restriction (Yes +, No —)	13	38	11	29	—
Mechanical Restriction (Restrictive +, Necessary —)	48	3	16	24	.01
Freedom to Experiment (Limited +, Extensive —)	26	25	15	25	—
Reaching Out (Intimidated +, Permitted —)	37	14	18	22	.016
Bodily Contact with Others (Limited +, Extensive —)	34	17	22	18	—
Time with Others (Limited +, Extensive —)	23	28	12	28	—
Motor Development (Encouraged +, At own rate —)	39	12	34	6	—

* The data on breast-feeding are given in a separate table.

† + indicates the more rigid pattern. — the flexible or permissive one.

‡ Significance level greater than .05.

13. Bodily contact with others: extensive—limited. Dealt with here are all answers which indicate the degree of active body contact the child has with others—how much is he held, carried, actively played with.

14. Time with others: extensive—limited. The concern here is simply with the amount of time the child is alone or in the company of other children and/or adults.

15. Motor development: encouraged—left to develop at own rate. This last category deals with the degree to which motor functions such as sitting, creeping, standing, walking, were anticipated and encouraged by the family, or left to develop at the child's own rate, without any pushing.

The reliability of judgment for placing subjects in these categories was in no instance lower than 90 per cent agreement for the examiner and one independent rater of the interview material.

The relationship of each of these child care practices to socio-economic background was determined by separate chi-square tables in which frequencies of each kind of child rearing practice were tallied for the two groups and compared for deviation from chance expectancy. Table 8 summarizes the results of these tests.

The comparison between breast-feeding and socio-economic group is given in Table 9. The chi-square for this table is 10.02 and is significant at the .02 level of confidence.

TABLE 9

DURATION OF BREAST-FEEDING COMPARED FOR GROUPS I AND II

	Not at All	*Up to 3 Mos.*	*4—5 Mos.*	*6 Mos. or More*
Group I ($N=51$)	19	28	3	1
Group II ($N=40$) ...	8	18	8	6

Of the 15 categories, the following show a significant relationship to socio-economic background: breast feeding is more prevalent and longer among Group II; feeding schedule and sleep routine are more rigidly enforced among members of Group I; discipline tends to be more restrictive among members of Group I; means of mechanical restriction are more often used to insulate the babies of Group I than of Group II from direct contact and interaction with their environment; reaching out motions of the child are more often discouraged in Group I. Of the remaining 9 categories which are not statistically significant, there is a tendency toward greater permissiveness on bottle-weaning, toilet-training, non-approved habits, and freedom to experiment in Group II. A greater proportion of children in that group also spend more time with others and have closer bodily contact with others, although again these differences are not statistically significant.

The results to this point indicate that (*a*) motor development is significantly higher among babies of the lower socio-economic group and that (*b*) certain child rearing practices are associated with socio-economic level. In order to establish whether a relationship exists between motor development and child rearing practice, the two groups of subjects were combined and bi-serial correlations computed between each child rearing practice (the dichotomy) and developmental quotients (the continuous variable). None of the correlations are above .40. Three were significant at the .05 level, one at the .01 level. The 4 of the 15 practices which have a significant relationship to motor development are:

1. Attitudes on non-approved habits (.05). Children from homes that are permissive rather than punitive about generally non-approved habits do better than children who are punished for non-approved habits (thumb-sucking, hair-pulling, etc, etc.).

2. Area restriction (.05). Children who are not restricted as to area, who can freely move about the home, have a higher motor D.Q. than children who are restricted and kept in one place.

3. Reaching out (.05). Children whose outgoing motions toward objects and persons are encouraged, who enjoy free and active interplay with their environment do better than those from homes where active interplay and reaching out is discouraged and punished.

4. Motor development (.01). Children who are left to develop at their own rate in the motor area do so more quickly than those whose motor functions such as sitting, standing, walking, etc., are anticipated by the family, who are "pushed" as far as their motor development is concerned.

Although none of the remaining catgories are statistically significant when correlated with motor development score, all show a trend in the same direction: permissiveness, flexibility, lack of restriction, enhance motor development as measured by the Gesell Developmental Schedules.

Global rating. The observations made on the 91 subjects whose homes were visited were rated by the examiner and again by an independent judge who had no knowledge of the subject's test performance.[9] These observations consisted of detailed notes on interaction between subject and adult as they appeared both at the time of the first contact at the hospital and again during the hour long home visit. The judges characterized each family as either permissive-accepting or rigid-rejecting. Eighty-six of the 91 interviews resulted in agreement. The remaining five homes were then discussed together and assigned to one or the other category.

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[9] The examiner did the ratings several months after the developmental examinations had taken place and when, in almost all of the cases, there was no recall of the subject's test performance.

TABLE 10

THE RELATIONSHIP OF GROSS MOTOR DEVELOPMENT SCORES AND HOME ATMOSPHERE RATINGS

	N	*Mean D.Q.*	*S.D.*	*P*
Total Group				
Permissive	65	114.03	14.99	.01
Rigid	26	100.73	11.29	
Group I				
Permissive	30	113.37	16.03	.01
Rigid	21	100.52	10.56	
Group II				
Permissive	35	114.60	14.26	.05
Rigid	5	101.60	15.40	

Of the 65 homes rated as permissive, 30 were from Group I, 35 from Group II. Of the 26 rated rigid, 21 were from Group I, 5 from Group II. Table 10 illustrates the significance of these ratings to motor development.

It is evident from Table 10 that the important determiner in motor development is the home atmosphere rather than the socio-economic status of the family. When the mean D.Q.s of the children of permissive families in Groups I and II are compared, no differences are apparent; neither do the D.Q.s differ for children from the homes rated as rigid in Groups I and II. When, however, separate comparisons are made within these groups, the children from permissive families show significant acceleration for Group I; for Group II the difference only approaches significance, probably because of the small number of rigid homes in that group.

DISCUSSION

Gross motor acceleration has often been one of the stereotypes attributed to the Negro child and the implication has been made in the literature as well as in the folklore that motor functioning among Negroes is advanced while the rest of mental development lags behind. The present investigation suggests that acceleration of gross motor development is not a "racial" characteristic but is, to an extent, related to the way in which a child is cared for and handled, in turn a function of socio-economic level.

The motor score D.Q.s of the subjects of the upper economic income group in this study approximated that previously established for white groups (5). The infants from the lower socio-economic group showed, on the average, gross motor acceleration.

The statistical difference between the motor score means of the two groups was small (at the .05 level) and a number of factors which may have reduced this difference are cited here.

1. The subjects of Group II were somewhat younger than those in Group I. In the present study as well as in previous ones (5, 6), motor development has been found to accelerate with age. Had the groups been equally matched for age at the time of examination, the difference in motor development might have been greater.

2. The previously cited New Haven study found that infants heavier at birth were favored in most fields of development (5). The mean birth weight of Group II infants was almost a full half-pound below that of Group I.

3. The possible retarding effect of certain environmental factors such as poor housing, for instance, can only be speculated upon as these were not specifically investigated here. However, some mention ought to be made of diet and its effect upon development. The lower birth weight of Group II infants is probably a reflection on the mother's less adaquate pre-natal diet and care.[10] No information was obtained on post-natal diet differences for the two groups. It is fairly safe to assume, however, that in a period of high food and other living costs, the family whose income is over $4,000 a year is better fed than the one whose income is below $2,000.

In view of the above, the difference in motor development score for the two groups might well have been greater if the subjects could have been equally matched for age and weight and if their diet could have been controlled in some way.

The differences in rearing practices established for the two groups closely correspond to previous findings. Davis and Havighurst (2), in a study of rearing practices in each of four groups (white middle, white lower, Negro middle, Negro lower class), found considerable class differences[11] which were greater than differences between Negroes and whites of the same social class. Middle class families were found to be more rigid in training for feeding and cleanliness habits, were less permissive in regimen. Ericson's (3) findings closely correspond to those of Davis and Havighurst. She further mentions the greater emphasis on achievement among the middle class, which is also more exacting in its expectations. This difference was very apparent in the previously described reactions on the part of the adults in the two groups to the initial testing situation. Manifestations of pressure on the child, concern about performance and achievement, anxiety about possible retardation, were prevalent among mothers of Group I and almost entirely absent among those of Group II. Ratings as to permissiveness-acceptance and rigidity-rejection made on the basis of observations bear out even more pointedly this difference between the groups. Only 5 of the 40 low-income group homes were rated as rigid, while 21 of the 51 homes in the high income group fitted into that category.

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[10] The average time for starting medical care during pregnancy for mothers in Group I was the second month; for mothers in Group II, the seventh month.

[11] Group I closely corresponds to Davis' and Havighurst's "middle-class," Group II to the "lower class."

The differences in care and handling which were noted might have been even more pronounced if all the subjects in both groups had been cared for by their mothers. A variable which was not at all controlled in the present study was the large number of working mothers in Group I.[12] In many instances in which the mother worked full-time, the child was cared for by a neighbor, relative, or paid domestic, who, if largely responsible for the child, also acted as informant in the interview. It is very likely that these mother-substitutes handled and cared for the children in a way that conformed much more closely than the mother's own to the standards of the low socio-economic group from which many came.

One other factor may have obscured the differences in rearing practices between the two groups. An implied assumption of the study was that Negroes from the upper socio-economic strata are closely identified with white middle class standards and also pattern their child rearing practices in conformity with those of the white middle class. Had the study been done some years ago, before "permissiveness" became one of the keynotes of contemporary child rearing philosophies, the difference between the two groups might have been sharper and more striking.

Just as Group II families were less rigid than those from Group I as to feeding, regimen, discipline, etc., they dealt less restrictively with the child's motor activities. The two practices in this area which show a statistically significant relationship to socio-economic group are "mechanical restriction" and "reaching out." Children in Group I are much more often insulated from their environment by cribs, tenders, high chairs, etc. These are not only used to sleep or feed the baby, as was their original purpose, but utilized, for a large part of the day, to set up a barrier between the baby and the people and objects around him. Group I babies have little active interplay with their environment and little opportunity for making outgoing, experimental motions. Taken as a whole and regardless of statistical differences, the picture for the subjects from the low socio-economic group is a much more active, free and uninhibited one; they have a closer, much more direct and manipulating relationship to their environment than the babies in the high socio-economic group.

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[12] Thirty-three of the original 54 mothers in Group I were employed, while only 10 of the 50 mothers in Group II were employed.

One of the major shortcomings of this study is that the information pertaining to motor activity and ways it is dealt with had to be gathered by means of an interview and an hour long observation period. The only adequate and satisfactory way of obtaining such information is through intimate knowledge of the child and prolonged, consistent observation of the child in interaction with those who care for him. While information on bottle-weaning or training can be elicited in fairly clearcut fashion by means of an interview, such concepts as insulation from the environment or freedom to experiment are hard to define, harder to elicit in an interview, and hardest of all to deal with in a purely quantitative manner.

There is an apparent contradiction on the findings between the relatively low level of significance when D.Q. scores and specific child care practices are correlated, and the highly significant relationship between motor development score and rating of home atmosphere as to permissive-accepting and rigid-rejecting. It will be recalled that these latter ratings were made on the basis of impressions of and observation on the interaction between adult and child during the first contact at the hospital and again during the home visit. These observations dealt not with the specific practices as did the interview, but with what can best, but only nebulously, be described as the "atmosphere" within which the child grows up, the "tone," the "feeling" of the home. Here again it is unfortunate that this descriptive, "qualitative" material had to be reduced to a rating. The most highly significant relationship, however, was found between these ratings and the motor development score, with infants from homes rated as permissive-accepting doing better on the Gesell Schedules than infants from homes rated as rigid-rejecting (the respective means for the two groups were 114 and 100). None of the correlations between score and specific practice, on the other hand, were above .40 and only 4 of the 15 practices show a significant relationship to score (although all are in the expected direction). One possible explanation suggests itself for this apparent inconsistency. It may be that the violation or observance of a specific practice is less decisive to motor development than the overall atmosphere within which a child is reared. In other words, and hypothetically, the feeding and training procedure for a given infant may be exacting, but if his overall relationships are accepting and warm, his motor development, as measured by the Gesell Schedules, will be enhanced.

A number of limitations should be mentioned which make all of the above suggestive rather than conclusive. One of these limitations is that only one examination was conducted with each child. The data might have been more conclusive if all of the subjects could have been re-examined at periodic intervals. This would, among other things, have provided some check of the child's state at the time of examination. It is quite possible, for instance, that the tension and eagerness to have the child perform which was so very much in evidence among the mothers in Group I had a negative effect on the subjects' performance. Furthermore, it was unfortunate that only the motor items rather than the entire Gesell scale were administered. Although the observations and initial interview supplemented the information obtained from the developmental examination and served to establish that the subjects were all within the range of normal development, it would have been preferable had this information been substantiated by Gesell material.

The results would have been considerably more meaningful if the age range of the subjects were less wide. The material would have been more conclusive had comparisons been made of children of the same age.

Another shortcoming is inherent in the Gesell scale itself. Toward the end of the first year, there are very few gross motor items and the difference from one key age to the next is often difficult to evaluate.

Finally it should be mentioned that a false inference which might be made from the above discussion is that if only given the proper stimulation and setting, an infant's motor development will flourish. Throughout this presentation the assumption has always been that a child's motor development may be accelerated or retarded by differential handling and home atmosphere but that this will only take place within the limits set by his endowment, be it high or low.

SUMMARY

The gross motor development of two groups of Negro infants from sharply contrasting socio-economic backgrounds was investigated in an attempt to determine whether gross motor acceleration is a "racial" characteristic or related to the manner in which an infant is handled and cared for. The infants from the low socio-economic group showed significant gross motor acceleration when compared to those from the high socio-economic group. Significant differences were also found for the ways in which the infants of the two groups were handled. Specific practices as well as the overall home atmosphere were more permissive and less exacting among families of the low socio-economic group. Differences in motor development were found to be related to methods of child care, with infants from permissive, accepting environments scoring significantly higher on the Gesell Developmental Schedules than infants from rigid, rejecting environments. The findings suggest that motor acceleration is not a "racial" characteristic.

REFERENCES

1. ANDERSON, J. E. *The young child in the home.* New York: Appleton-Century, 1936.
2. DAVIS, ALLISON, and HAVIGHURST, R. J. Social class and color differences in child rearing. *Amer. sociol. Rev.*, 1946, 11.

3. Ericson, Martha C. Child rearing and social status. *Amer. J. Sociol.,* 1946-47, 52.

4. Gesell, A., and Amatruda, Catherine. *Developmental diagnosis.* New York: Hoeber, 1941.

5. Pasamanick, B. A comparative study of the behavioral development of Negro infants. *J. genet. Psychol.,* 1946, 69.

6. Pasamanick, B., and Knobloch, Hilda. Further observations on the behavioral development of Negro infants. Unpublished manuscript.

7. Scott, R. B., Jenkins, M. E., and Crawford, R. P. Growth and development of Negro infants: Analysis of birth weights of 11,818 newly born infants. *Pediatrics,* 1950, 6.

8. 1950 census of population preliminary reports. Washington, D.C.: U.S. Dept. of Commerce, Bureau of the Census, 1951.

THE EFFECTS OF A MOTOR HANDICAP ON PERSONALITY: I. THE EFFECTS ON LEVEL OF ASPIRATION[1]

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Any comprehensive theory of personality must recognize the important role which the motor apparatus plays in a child's development. To mention just a few examples: it enables him to explore his environment and to develop techniques for independent mastery of problem situations; in his defense repertoire it is activated during the flight which accompanies fear, the destructiveness which accompanies anger, as well as the inhibitions which accompany the formation of conscience; it allows for the expression of free energy in play and other creative activities.

It follows, then, that a motor apparatus which is not intact should present problems which affect the child's entire personality structure. The following studies were designed to explore the effect of motor handicap on certain aspects of the child's personality.

STATEMENT OF THE PROBLEM

There are many reasons for hypothesizing that a child with a motor handicap will face special problems in setting realistic goals for himself. To begin with, his ability to perform efficiently is often seriously disrupted, leaving him with a confusing inconsistency in regard to how he will perform in the future. His parents have to deal not only with unsettling emotional attitudes which may be aroused in such a child, but also with a far less clearly defined standard of growth by which to gauge his development. Thus, the child is more likely to be pushed by a parent who believes he is especially gifted or overprotected by one who believes he is relatively helpless. Finally, there are many areas in which the behavior of his non-handicapped peers cannot be used to set the standard of expected achievement.

The present study was designed to test the hypothesis that the goals which a handicapped child sets for himself differ significantly from those of a non-handicapped child. Neither theoretical nor clinical observation is refined enough, however, to enable one to predict specifically what the

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[1] These studies were sponsored by The Coordinated Program for Handicapped Children, and were done at The Institute for Psychosomatic and Psychiatric Research and Training, Michael Reese Hospital, Chicago, Ill.

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difference will be: e.g., whether he will set unrealistically high goals in order to compensate for his handicap, unrealistically low goals in order to protect himself from failure, or whether he will adopt some other pattern of goal setting which differs from that of the non-handicapped child.

METHOD

Subjects. The subjects were 12 children with no motor handicap, 12 with a mild motor handicap, and 12 with a severe motor handicap. All were pupils in the Chicago public school system, between the ages of 8 and 10, of average or above intelligence, with no other severe physical handicap. The age range was chosen as representing a particularly stable period in the child's development, since the transition from a life centering around the home to one centering around both school and home has usually been made, and the difficulties of early adolescence have not yet started. The reason for equating the groups for intelligence and limiting the experimental groups to a single handicap was to see the effects of the motor handicap uncomplicated by such factors as mental retardation and other types of physical defects, both of which could have a significant effect on personality.

In all cases the handicapped children were suffering from different kinds of cerebral palsy and the motor handicap had been present from birth. Two criteria were used to determine degree of handicap: first, a rating by the examiner based on observing the child's gross motor coordination in class and on the way to the testing room, and observing his finer motor coordination in handling the test material; second, an objective criterion in terms of the number of pegs the child could place in a pegboard in a 20-second interval. It should also be noted that there were two criteria for the moderately handicapped group: a moderate or mild case of spasticity or athetosis affecting all limbs, or a severe spasticity which affected only two limbs, leaving the other two relatively intact. The only practical limitation for the severely handicapped group was that the child could not be so crippled as to be unable to handle the material used for testing.[2]

It is important to emphasize that the control group was made up of non-handicapped children, and no attempt was made to get normal, well adjusted individuals. Since the handicapped children were selected with

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[2] The handicapped groups consisted of 12 spastic and 12 athetoid children, and all the data were analysed according to type of handicap as well as severity. When this was done there was either no significant difference between the groups, or the differences were so unsystematic that they had little psychological meaning. However, one cannot conclude from this that the type of handicap does not significantly affect the personality variables tested because it was impossible to equate the groups for severity—the spastics contained a predominance of moderately handicapped children while the athetoids contained a predominance of severely handicapped children. Thus, with this sample, the findings are indeterminate when examined in terms of kind of handicap.

a complete disregard to the type of adjustment they were making, it would be erroneous to compare them with a special segment of the non-handicapped children whose adjustment was outstandingly good.

Procedure. The experiment consisted of a slightly modified form of the level of aspiration technique. The subject was seated at a table upon which there were two pegboards, each 36 × 5 × 1 inches. Each board contained 20 square holes ⅜ inch in diameter. The board the subject was to use had a square peg 4 inches long and ⅜ inch in diameter in front of each hole. Instructions were as follows: "This is a game to see how many of these pegs you can put in the holes before I say *Stop*. You see, they go in like this (illustrates with three pegs). Now you try a few. (Subject places three.) Fine. Now, when I say *Go*, you start and put in as many as you can till I call *Stop*."

For this and each of the subsequent trials, the subject was given 20 seconds. At the end of each trial the number of pegs were counted and recorded, and the board was left in the subject's view. The other board was placed in front of him and he was asked, "How many do you think you can put in this time? You will have the same amount of time before I call *Stop*."

There were five such trials, each of 20 seconds duration. For each trial both the achievement score (number of pegs placed in the 20-second interval) and the level of aspiration (the number of pegs the child said he could place on the following trial) were recorded. The wording of the instructions and the technique of leaving the board with the previous performance in full view of the subject were designed so as to obtain the child's realistic evaluation of what he could do, rather than a wishful estimate of what he would like to do.

RESULTS

The initial problem was to determine whether there was a significant difference between the three groups in the over-all height of their level of aspiration. The measure used was the discrepancy score which was obtained by subtracting the number of pegs placed on a given trial from the subsequent estimate of the number the subject thought he could place —i.e., subtracting the achievement score from the subsequent level of aspiration. Since there were five trials, each subject had five discrepancy scores. The mean discrepancy scores for all five trials for each of the three groups ($N = 12$) are as follows:

Non-Handicapped	*Moderately Handicapped*	*Severely Handicapped*
1.93	1.98	1.18

An analysis of variance was done and an F of 1.43 was obtained. Since an F of 3.30 is necessary for significance at the .05 level of confidence, one can conclude that there is no significant difference between the mean discrepancy scores for the three groups. This means that there is no general

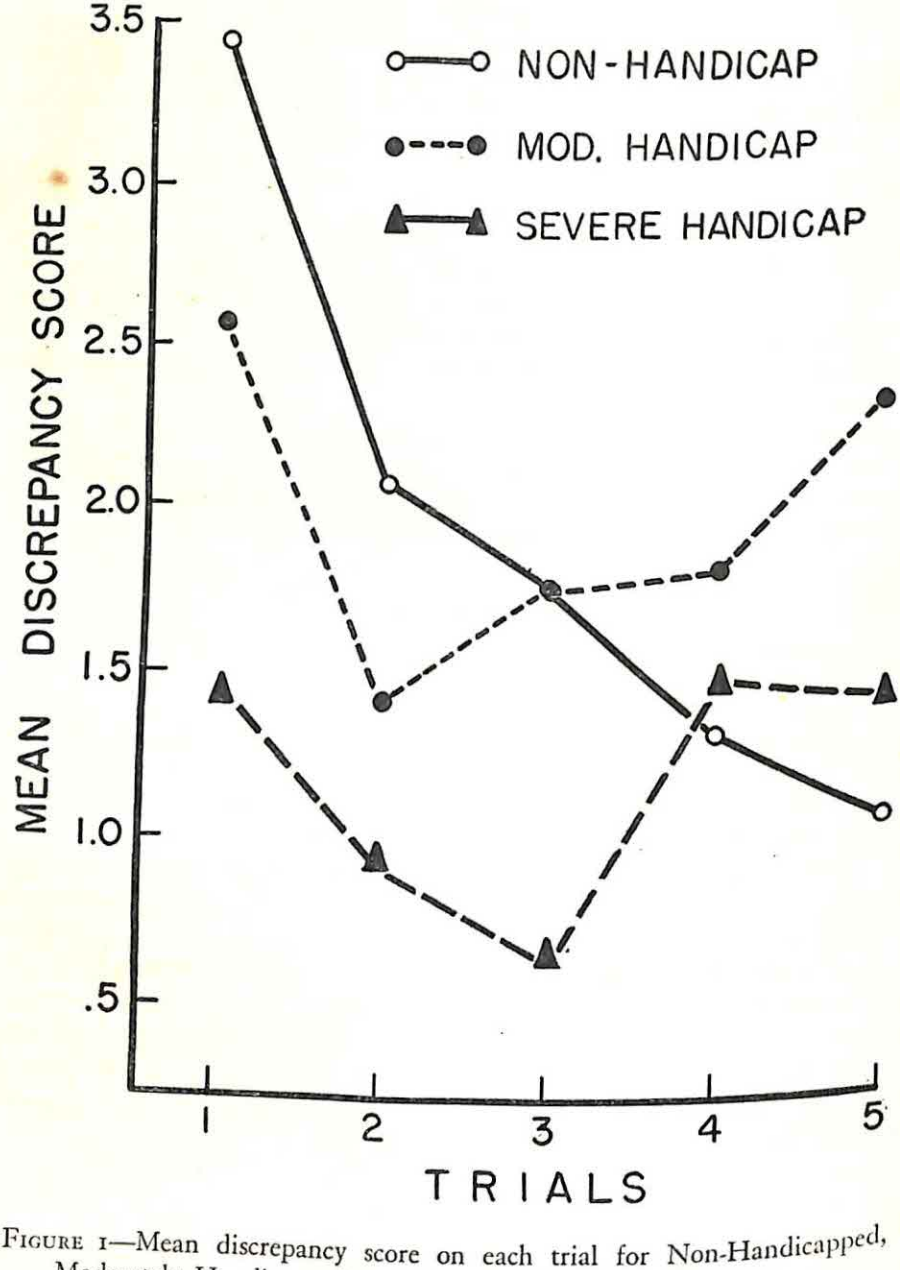

FIGURE 1—Mean discrepancy score on each trial for Non-Handicapped, Moderately Handicapped, and Severely Handicapped groups.

tendency for handicapped children to set consistently higher or lower goals for themselves than non-handicapped children.

However, inspection of the data indicated that the pattern of change in discrepancy scores from the first to the fifth trial might be different for the three groups. Therefore the mean discrepancy score for each of the five trials was obtained and were plotted on Figure 1.

A trend analysis was run and an *F* of 2.31 was obtained, which is significant at the .03 level of confidence. Thus there is a significant difference between non-handicapped and handicapped children in the goals they set for themselves as they continue working at a task. The non-handicapped group starts with high goals relative to achievement and gradually decreases this discrepancy as the task is repeated. The handicapped groups are characterized by (*a*) a systematic decrease in the initial height of the goal as the handicap becomes more severe, and (*b*) after an initial decrease in the discrepancy between achievement and performance, a reversal of the trend toward setting higher goals as the task is repeated.

Before discussing the meaning of these results and how realistic such goal setting behavior is, the actual achievement scores for the three groups must be examined since there is no reason to assume equal facility in performing the task. In order to obtain a general measure of improvement with practice, the number of pegs on the first trial was subtracted from the number on the last trial and group means were calculated. These means are as follows:

Non-Handicapped	*Moderately Handicapped*	*Severely Handicapped*
2.58	0.67	0.58

An analysis of variance yielded an *F* of 16.06, which is significant at the .01 level of confidence. Thus, non-handicapped children improve with practice to a significantly greater degree than handicapped children, whose over-all improvement is relatively small.

In order to obtain a picture of change in performance from trial to trial the mean achievement score on each trial was calculated for each of the three groups. These means are presented in Table 1.

The pattern of achievement is quite different for the three groups. For the non-handicapped children there is a dramatic initial improvement followed by a rapid deceleration. For the moderately handicapped children the improvement is very slow and difficult. For the severely handicapped children the achievement pattern is erratic and unpredictable, with improvement followed by poor performance.

Discussion

The two aspects of the present findings which will be discussed are (*a*) the initial difference in discrepancy scores of the three groups reflecting the

TABLE I

MEAN ACHIEVEMENT SCORES FOR TRIALS 1 THROUGH 5 FOR NON-HANDICAPPED, MODERATELY HANDICAPPED AND SEVERELY HANDICAPPED GROUPS

Trials	*Non-Handicapped*	*Moderately Handicapped*	*Severely Handicapped*
1	13.50	9.16	2.83
2	15.41	9.41	3.16
3	15.41	9.75	3.66
4	16.08	9.83	2.91
5	16.00	9.83	3.41

fact that the level of aspiration was progressively lowered as the severity of handicap increased; and (*b*) the progressive lowering of the discrepancy score on the part of the non-handicapped group as the task was repeated, in contrast to the initial lowering and subsequent raising of the discrepancy scores on the part of the handicapped groups. The primary emphasis will be on the question of how realistic such patterns of goal setting are. In general, the discussion will follow Lewin, Dembo, Festinger, and Sears (2, pp. 333-378), who regard level of aspiration as the product of the desires to seek success and avoid failure, plus such factors as the subject's evaluation of his abilities, the nature of the task itself, group standards of performance, etc. The desires to seek success and avoid failure can be considered as motivational factors, while the remaining can be considered cognitive factors.

In regard to (*a*), it is not necessary to assume a difference in motivation in the three groups. This is because there is an important cognitive difference resulting from the difference in abilities of the groups. An improvement of two pegs is well within the realm of possibility for the non-handicapped child, but would be extremely difficult or impossible for the handicapped one. Experimental evidence (1) indicates that, when faced with a difficulty continuum, the individual will set up goals near the boundaries of his abilities. Since such boundaries are much more limited for the handicapped child, it is reasonable for him to lower his initial level of aspiration. Expressed in another way, it would be highly unrealistic for the handicapped child, with his limited abilities, to aspire to achieve to the same degree as the non-handicapped child. Thus, the initial lowering of discrepancy scores with increased handicap can be accounted for in terms of a realistic limiting of goals in keeping with diminished ability to achieve.

In regard to (*b*), the progressive lowering of the discrepancy scores on the part of the non-handicapped child indicates a realistic adjustment to a task in which improved performance becomes progressively more difficult. However, the handicapped children seem to be able to maintain the realistic lowering of discrepancy scores only for a limited time, after which there is an increased disparity between what they actually achieve and what they aspire to do. This finding is all the more striking when one considers that, in reality, they can improve very little and, on this basis, should become more conservative in their estimates of future performance. There is experimental evidence (3) that such a phenomenon is seen in the case of children who in their daily lives are often unsuccessful in achieving what they set out to do. According to Lewin *et. al.*, such repeated failure leads to emotionality and unrealistic attitudes. In the present study, the handicapped children not only failed to attain their initial goals but, unlike the non-handicapped children, failed to improve the level of their performance significantly. One can speculate that it is the frustration of slow, minimal improvement or erratic, unpredictable performance which increases the emotional tension and gives rise to a more unrealistic attitude. It is also possible that the handicapped children bring to the task a longer history of past failures and performance under the pressure of cumulated frustrations. In this regard a level of aspiration study using a non-motor task would make an interesting comparison study.

Although there is good reason for describing the increase in discrepancy scores on the part of the handicapped children as unrealistic, it is impossible to determine what psychological attitude accompanies this change. With non-handicapped children it has been shown that such behavior goes along with feelings of dissatisfaction with status and lower self-confidence. Whether this is true of handicapped children can be determined only by further investigation. Perhaps the most conservative speculation is that the change is from a realistic to a wishful attitude. Initially the handicapped child can maintain the realistic attitude of trying to keep his goal in line with his achievement; but, under frustration of his limited or unpredictable achievement he comes to think in terms of how well he would like to do.

Summary

In order to determine the effect of a motor handicap on setting goals of achievement, 12 non-handicapped, 12 moderately handicapped, and 12 severely handicapped children were given a level of aspiration task involving five trials of putting pegs in a pegboard. There was no significant tendency for the handicapped groups to set higher or lower goals for themselves when all five trials were combined. However, there was a significant change in pattern of goal setting from trial to trial, the non-handicapped group progressively lowered their level of aspiration, in contrast to an initial lowering followed by a reversal toward setting higher goals as the task was continued on the part of the handicapped groups. This was interpreted as meaning that, when faced with a motor task, the handicapped child can maintain a realistic attitude toward his capabilities for only a limited period of time; then, under the pressure of the frustrations of limited or unpredictable achievement, his attitude changes to a wishful one of what he would like to be able to do rather than what he is capable of doing.

REFERENCES

1. HOPPE, F. Erfolg und Misserfolg. *Psychol. Forsch.*, 1930, 14, 1-62.

2. LEWIN, K., DEMBO, T., FESTINGER, L., and SEARS, P. S. Level of aspiration. In J. McV. Hunt (Ed.), *Personality and the Behavior Disorders.* New York: Ronald Press, 1944.

3. SEARS, P. S. Levels of aspiration in academically successful and unsuccessful children. *J. abnorm. soc. Psychol.*, 1940, 35, 498-536.

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DEVELOPMENTAL TRENDS IN THE ABSTRACTION ABILITY OF CHILDREN[1]

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Abstraction is "a mental process in which some attribute or characteristic is observed independently of other characteristics of an experience as a whole." Werner (26) emphasizes that the ability to abstract does not appear suddenly in the course of the individual's development; rather it is present from the very beginnings of life but changes qualitatively with progress in maturation.

Different organizational patterns of response to environmental stimuli are observed in children of varying age levels (26). The abstraction behavior of very young children seems to be primarily on a sensori-motor level and can be designated as *perceptual*. In such a response the individual yields to demands of the situation, and the organization of the material is determined by the nature of the stimuli as well as by the limited maturity of the subject. A more mature individual would be expected to consciously impose organization on the material (1, 7, 14, 17, 19, 26) and classify the material into deliberately conceived categories. This is the *conceptual* level of abstraction.

The hypothesis that the younger the child, the more perceptual are his organizations has been stated (1, 7, 14, 26) but a search for specific details of the development encounters a paucity of data. The present study was undertaken to obtain information regarding changes in abstraction ability during the elementary school period.

PROCEDURE

Candidates for study were boys of lower-middle-class background who were in the correct grades for their ages and whose percentile ranks on the Raven Test of Progressive Matrices were between 25 and 75. From candidates 7, 9, and 11 years old, 20 were chosen at random to represent each age group.

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Toy objects were selected as the basic item for the grouping tests, and pilot exploration resulted in assembly of 24 items which were familiar to all of the children. Except for the snake, which was about 12 inches long, the maximum dimension of any object was 5 inches. The following objects were used:

1. Blue and red plastic lounge chair
2. Red plastic office chair
3. Brown and white plastic arm chair
4. Red plastic stool
5. White plastic dining table
6. Red plastic end table
7. Plastic man in black suit and white shirt
8. Plastic woman in blue dress
9. Flesh pink rubber baby doll
10. Flesh pink celluloid child doll
11. Brown metal soldier
12. Metal boy in blue suit
13. Green plastic truck
14. Blue plastic baby carriage
15. Purple plastic airplane
16. Red and yellow plastic tractor
17. Blue metal train engine
18. Red and blue plastic boat
19. Brown metal chicken
20. Red celluloid fish
21. Pink celluloid duck
22. Red plastic horse
23. Green wood snake
24. Black and white plastic dog

Five variants of the test situation were used:

Form I—Tactual-motor. The subject was permitted to handle the objects while making his groupings.

Form II—Visual-non-motor. The subject was not allowed to touch the objects but was asked to point to or name the objects and instruct the tester on grouping.

Form III—Pictures. Black and white photographs mounted on cards approximately 3.5 × 4.5 inches were substituted for the objects, and the subject was allowed to group the cards manually.

Form IV—Names. The name of each object was printed in large, black block letters on a card approximately 3 inches square, and the subject was asked to group the cards.

Form V—Names listed. The names of all objects were typewritten on the upper one-half of a sheet 11 × 13 inches, and the subject was asked to write the names in groups on the lower one-half of the sheet.

Within each age group the order in which the five forms were given was rotated so that four subjects of the twenty did Form I first, four did Form II first, etc. In the presentation of each form the materials were arranged in a circle on a table so that two objects obviously of the same class were not adjacent. The same arrangement of materials was employed with all subjects.

Before testing, each child was asked to identify the objects as they were placed on the table or to read the names on cards as listed. Before each test a subject was told to "put those things together in a pile (or list) that belong together or go together or are alike in any way, and those other things that go together or belong together or are alike in another way in another pile (or list). You may have as many or as few piles as you wish. Do you understand?" Some seven-year-olds found the concept of "belongingness" or "likeness" difficult to grasp. Examples were not given because they might set a pattern and deter spontaneous grouping. When a child seemed not to understand or asked whether there was a right way to group, the directions were repeated. Judged by the performances of the children, the task was comprehended.

Minimum control was exerted by the experimenter in the first test situation, the child being left to determine what made things similar or belong together. Trials were completed in not more than ten minutes. After completion of the first trial, a subject was asked to explain the reason for each group. The names of objects in each classification and the reasons for groups were recorded *verbatim*. To determine the upper limits of grouping and the effects of pressure, additional trials were used.[2] Each child was instructed to "group the things that are alike or belong together into fewer groupings than you made the first time," until the children could not reduce the number of groupings. After the objects were grouped, the reasons for grouping again were recorded *verbatim*. Identical procedure was followed with each of the five test forms. Each child was given one test daily for five consecutive days to reduce fatigue and perseveration.

Upon completion of the five test forms, each subject was given a class recognition test to determine his ability to recognize bases of groupings possibly more inclusive than any he had devised. Successively, a child was introduced to the groups of objects which could be classified as animal, human, vehicle, and furniture and was asked, "Do these things go together or belong together or are they alike in any way?" If these were identified, the experimenter presented to the child the 24 objects in two groups, those "living" and "non-living," and asked the same question. If these were identified, the 24 objects were placed in a single group, and the child asked the basis of it. Finally, the subject was exposed to the classifications "red" (office chair, stool, horse, fish, end-table) and "metal" (train engine, soldier, boy, chicken).

For scoring on the basis of the number of objects placed in each category, designations of groupings were classified as perceptual, conceptual, and miscellaneous; sub-categories were required for the first and last of the three classifications. The designations are similar to those used by Bolles (1), Goldstein and Scheerer (7), and Werner (26).

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[2] The first and second trials were only used for analysis since too few children in the sample were able to reduce the groupings in Trial 3.

A. *Perceptual*

1. *Affective*—grouping based on feeling.
2. *Identity*—grouping based on identity of structure or function.
3. *Partial Identity*—grouping based on identity of certain aspects of structure or function.
4. *Centroid*—grouping based on belongingness in a geographical area.
5. *Functional*—grouping based on use.

B. *Conceptual*—grouping in which the objects were treated as members of a class even though gross structural differences were apparent. Designation by a class name was required for a grouping to be scored conceptual.

C. *Miscellaneous*

1. *Mixed-1*—grouping in which conceptual and perceptual classifications are combined and treated as perceptual.
2. *Mixed-2*—grouping in which two or more perceptual groupings are combined into a third perceptual category.
3. *Thematic*—grouping based on a story.
4. *Pseudo*—grouping which appeared incorrect in interpretation or information of reality.
5. *Non-Groupings*—objects which were not found to belong to any grouping and which were isolated intentionally.

The miscellaneous categories were derived from a pilot study and are recognized as a heterogeneous combination of sub-categories necessary to demonstrate adaptations in sorting behavior when "pure" conceptual or "pure" perceptual organization was not exhibited.

RESULTS

The frequency with which the children of three age groups made use of the perceptual and conceptual classifications in Trials 1 and 2 is shown in Figure 1. By an analysis of variance technique (4) the age differences indicated in the chart for conceptual classifications in Trial 1 were significant at the .01 level of confidence. Differences in the use of conceptual categories also were significant for every age comparison in Trial 2. The age differences in perceptual classification in Trial 1 were significant between the group of children 7 years old and both of the older groups but were not significant between groups 9 and 11 years old. In no instance were dependable differences found between tests (18).

Comparisons between Trials 1 and 2 for groups of children 7, 9, and 11 years old did not show significant changes in the use of perceptual

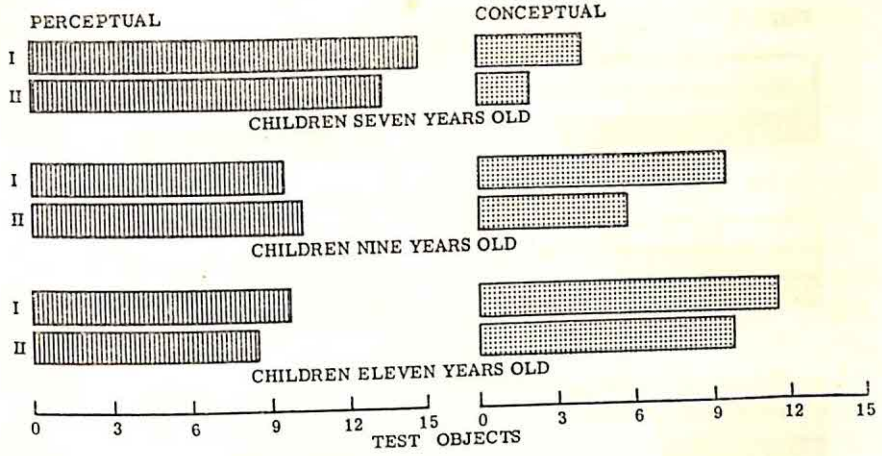

FIGURE 1—Comparisons of mean numbers of objects placed in perceptual and conceptual categories by children of three age groups.

type classifications although the direction of change was toward an increased use in Trial 2 by the nine-year-olds and decreased use by the other two groups. With respect to conceptual classifications all groups showed changes significant between the two trials at least at the .05 level of confidence. However, in both trials the trends with increasing age were similar downward for use of the perceptual categories and upward for the conceptual classifications.

The percentages of objects grouped according to the subcategories of the perceptual and miscellaneous[3] classifications are shown in Figure 2. The children never used the "affective" category and the "identity" category was omitted because with the test objects employed, identity might have been a conceptual approach in some instances and a perceptual approach in others.[4]

In both trials the children 7 and 11 years old employed the partial identity category as a basis of grouping significantly more than did the nine-year-old children. Similarity is apparent between the results for seven- and eleven-year-old groups, yet one would expect to find differences, since maturity is a factor in differentiating the types of classificatory approaches used. If the reasons offered for the groupings are considered, the seven-year-olds classified significantly more frequently on the basis of partial identity of action than did the nine- and eleven-year-olds. The two older groups

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[3] It was felt that in view of the heterogeneity of the miscellaneous category, it would not be valid at this time to treat them as a single unit. Analysis of these results, however, will be presented later.

[4] Nevertheless, the use of what might be considered "identity" was rare. This might have been a function of the materials, since no two objects were identical.

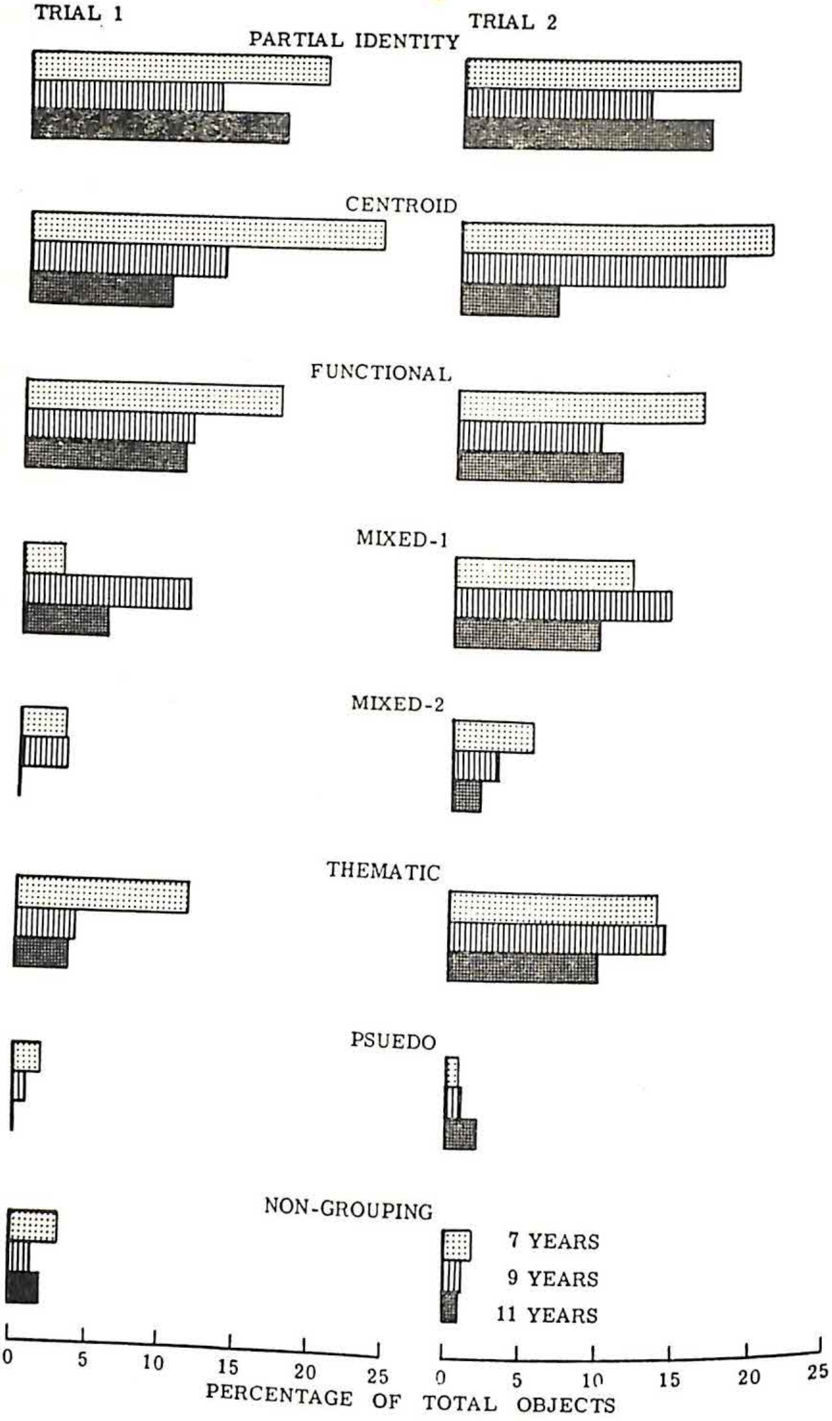

FIGURE 2—Comparisons of percentages of total number of objects placed in perceptual and miscellaneous categories in Trials 1 and 2 by children of three age groups.

tended to use partial identity of structure, although the differences between the nine- and eleven-year-olds is not significant. Partial identity of structure was used significantly more by the eleven-year-olds than by the seven-year-olds.

The centroid grouping was employed by the youngest children more significantly and use of that category was less for each older age group. Typical reasons given for the groupings were: "all belong in air," and "all belong in the house." Objects were organized in ways familiar to the child from his own experience or from stories and explanations. The trend described occurred in Trial 2 also, although the nine-year-old children increased their use of this type of classification.

The seven-year-old children also employed functional grouping significantly more than did the older children. Nine- and eleven-year-old children used the category almost equally. Under pressure to reduce the groupings, the eleven-year-olds increased the frequency of their use of this classification but the other two groups did not.

Examination of the uses of the miscellaneous groupings shows that in the first trial the combining of the perceptual and conceptual approaches (mixed-1) occurred most frequently among nine-year-old children. The combination of two or more perceptual categories (mixed-2) was used almost equally by the seven- and nine-year-olds, but rarely by the older children. In Trial 2, however, all groups increased their use of the mixed categories, the greatest increase being for the oldest children.

Use of the thematic category decreased with age, the seven-year-old group using it most frequently. In Trial 2, however, the nine-year-old children increased their use of this approach to an extent that results for the seven- and nine-year-old groups do not differ significantly. The eleven-year-old children also increased their use of thematic groupings in Trial 2.

Subsumed under the category "pseudo" are the groupings meaningless to us. This and "non-grouping" appeared rarely and most frequently in the seven-year-old group. The children had the most difficulty with the category "vehicle," which some did not use at all. More frequently, the failure involved only the baby buggy. Even eleven-year-old children often did not think of this classification. The difficulty may have stemmed from the fact that baby buggies have no motors as do the other vehicles represented. Another possibility is that the children may have considered it part of the family's furniture. The boat, the snake, and the fish also presented difficulties and frequently were left ungrouped, especially by the seven-year-old children.

The question arises, can the child who does not in spontaneous groupings use such categories as animal, vehicle, furniture, human, redness, and metal, identify such classfications when the groupings are made by the experimenter? The results of the recognition test are summarized in Table 1 and demonstrate that the ability to identify groupings increases with age.

TABLE I

PERCENTAGES OF GROUPS OF CHILDREN WHO IDENTIFIED GROUPINGS IN RECOGNITION TEST

Groupings	*Age Groups* (years) *7*	*9*	*11*
Animal	50	75	90
Human	60	85	95
Vehicle	0	40	50
Furniture	40	90	90
Living	0	40	35
Non-living	0	15	15
Single Group	0	0	25
Red	5	20	10
Metal	0	0	10

The similarity between scores of the nine- and eleven-year-old children is greater than between those of either group and the seven-year-old children. Only the nine- and eleven-year-old youngsters were able to identify the category "living things" and only eleven-year-old children were able to give some adequate reason for grouping all the objects into one category. More of the nine-year-old group were able to identify the "red" category than either of the other two age groups. Only two eleven-year-old subjects were able to identify "metal" as a basis of classification, perhaps because the metal objects were painted. All children gave some basis for their designations of the groupings, but their reasons were not always correct in terms of conceptual response. Usually, the explanations were not different from those offered for their own classifications.

DISCUSSION

The classificatory behavior represented in the first trial indicates the child's ability in a situation which is minimally structured. The children were free to use the approaches they "felt most comfortable" with in determining similarity or belongingness. The trends are clear cut that regardless of the nature of the material, perceptual classifications declined and conceptual ones increased with age. This finding substantiates the hypothesis that with increases in age significant changes in classificatory behavior occur. The specific determinants effecting this change are difficult to isolate. Although the group trends reported are clear cut, individual variations within the groups in the use of "more mature" classificatory approaches were found. Some seven-year-olds were able to utilize conceptual as well as perceptual approaches. What accounts for the individual variations becomes a highly relevant and pertinent question. Since chronological age and social class are controlled, and since the mental ability range within the groups did not include extremes, the questions point to areas of experiential, personality and organic forces as possible determinants of the difference. Factors such as quality of experience with similar problems, early learnings of concepts, reality "boundness," and rate of constitutional maturation offer themselves as possible determinants of the variations observed. Further experimentation with variables such as these is necessary.

Whatever the reason, the results of this study tend to confirm those reported in the literature (1, 7, 15, 19, 21, 26). The various uses made of the sub-categories is an important consideration. The total perceptual score is a composite of all the perceptual sub-categories. Hence, to state that perceptual classifications decrease with age is merely a half truth. Examination of the perceptual sub-classifications reveals significant differences in the frequencies with which they were used. Partial identity was used by the two youngest age groups with about the same frequency. The results, however, differ qualitatively in a way that tends to confirm the view of Werner (26) and Koffka (12) that action and movement are abstracted earlier than structural aspects. Thus, this quality is a significant indicator of maturity differences. The seven-year-old child, perhaps since his early experiences with objects are in terms of movement, has not yet replaced this more primitive learning with that which is more sophisticated. The question also arises as to the relationship between partial identity of structure and conceptual classificatory ability. It is the oldest group, the one in our population most able to handle the material conceptually, that tends to use this approach. Is the structural approach intrinsic to or correlated with conceptual thought? It may be that the two are interdependent.

Similarly, in the centroid grouping the specification of location as a determinant of belongingness or similarity emphasizes the more concrete nature of the younger children and indicates inability to perceive the materials in the "abstract," that is, not tied to specific places or persons. That this approach declines so sytematically with age would support this premise. The same thinking holds with respect to the functional approach. The inability to see objects as representing classes of material; rather, the perception of them as similar by virtue of utility is further evidence of concreteness.

It is not surprising that seven-year-old children have difficulty in using the mixed-1 category frequently, for use of this approach is correlated with the ability to use the conceptual category. By definition, children could not be expected to use mixed-1 with any greater frequency than they were able to use the conceptual category. Of interest, however, is the frequency with which the nine-year-old children used this approach. Figure 2 indicates their preference for a combined approach in at least one conceptual category.

This suggests that not being quite ready to see the objects only as member components of a class of objects, they prefer to associate the objects with something concrete, thereby adding the perceptual concept to the classification. It is clear that mixed-2 is used infrequently by this group and the eleven-year-olds have no need to use the approach at all.

The rationale of using additional trials to indicate the extent of approach and, to some degree, the stability as well as the solution to a more complex request for grouping was substantiated by examining the shifts that did take place.

The changes that occurred in the second trial reflect the children's ability to reorganize their groupings in new ways. Some of the children included more objects within the groupings which they had already established. For example, a seven-year-old child who in Trial 1 made three centroid groupings, in Trial 2 merely brought them together into one centroid group. The idea used to explain the grouping was enlarged in scope and inclusiveness, but the type of grouping remained the same. This did not actually involve a shifting of the basis of the groupings, for the child did not select a new classificatory scheme by which more objects could be included. The child could shift within narrow limits, for he had to reorient the classificatory scheme applied to the objects, but he was not able to find an essentially different basis for groupings.

Some children were able to shift from perceptual to conceptual classifications, which involved utilization of classifications essentially different from those used in the previous organization. For instance, one change was from a grouping in which animals were placed together "because they live on a farm" to a grouping of the animals "because they are animals." The type of shifting involved in this situation requires a greater degree of flexibility than is required in the example cited previously, a reorientation of "attitude" toward the objects to perceive them in a basically different way. This ability to shift from perception to conception is evidence that a child is well established in the use of the categorical approach.

In Trial 1, one seven-year child made four groupings: (1) the fish, the snake, the duck, and the boat, "because they all belong in water" (scored centroid); (2) the boy, the man, the woman, the soldier, the doll, and the baby, "because they are all people" (scored conceptual); (3) the tractor, the truck, the plane, the train, "because they all run and run on the ground" (scored mixed-2); and (4) the horse, the dog, the chicken, "because they all walk" (scored partial identity). In Trial 2 he made three groupings: (1) the vehicles, except the baby carriage, "because they are all things you travel with" (scored functional); (2) all the animals "because they are animals" (scored conceptual); and (3) the furniture and the people "because people sit and use the furniture" (scored mixed-1). This record clearly shows shifting from the original approach and the inclusion of a new conceptual category not used in Trial 1. It is true that the child used a conceptual classification in the first trial, which might be related to his ability to make another conceptual grouping in Trial 2 and bring all the animals into one group regardless of differences in structure. He did not alter his original conceptual grouping, but to make fewer groupings, as directed, he had to group humans and furniture together in a mixed category.

Such findings indicate that individual differences in ability to handle some types of material conceptually and to shift are found as early as the seventh year. Whether vocabulary, unique experience favoring concept formation, certain types of innate ability, maturational factors, or personality determinants affect the abilities of the youngsters is still an open question.

Principally, shifting by the nine- and eleven-year-old children was toward combining classificatory types. The general trend was toward fewer items grouped conceptually and more items grouped in miscellaneous categories. However, nine-year-old children were able to expand their conceptual groupings in Trial 2 by changing to animals or to humans from centroid categories. The Raven scores of children able to effect these changes ranged from the 50th to the 75th percentile.

Only one eleven-year-old child, whose Raven score was around the seventy-fifth percentile, grouped all of the objects into one category "because God created all these." Although performance of this level is rare, it is significant that eleven-year-olds shifted from perceptual to conceptual approaches with greater frequency than did seven-year-olds. The fact that many of the children were unable to make fewer groupings in Trial 2 than in Trial 1 indicates a type of rigidity, a kind of "boundness" to the already achieved tasks. Our justification for qualifying rigidity is simply that we are using a limited measure of rigidity or flexibility, i.e., rigidity with respect to number of groupings. If we had asked that the children merely alter the groupings, without requesting change in number of groups, more intensive rigidity might have been detected. The two types of shifting described indicate that a reorientation in approach toward objects occurs as early as age seven. Developmentally the trend from shifting within a single approach to shifting from one classificatory scheme to another may well be a key to the maturity index of conceptual thinking. The seven-year-old who can do this, therefore, is more mature in his abstraction ability than the seven-year-old who cannot, if maturity be considered in terms of the degree of similarity of performance from the young to the older. It would be interesting and fruitful to explore this question further by finding out if such differences relate to language ability or problem solving ability.

The findings of the "Recognition Test" show interesting agreement with those of Welch (23), who tested the ability of children to learn certain abstract concepts rather than the frequency in the use of the concepts.

The recognition test showed that the use of hierarchic levels in grouping material increases steadily with age. The designation *conceptual* in this study actually was applied to groupings which Welch would have called second level—the "animal," "human," "vehicle," and "furniture" categories. The categories "living" and "non-living" are third level and "substance" is fourth level in Welch's system.

We have pointed out the difficulties seven-year-old subjects had in identifying even second level concepts, as well as their inability to identify third and fourth level ones. Although results of the study showed definite changes with age in the ability of children to identify groupings, the problem remains of explaining why certain groupings are more readily identified than others. The effects of qualitative differences in experience upon the formation of concepts needs further analysis.

SUMMARY

Sixty white lower-middle-class children, 20 from age group 7, 9, and 11 years, who were in the correct grades for their age and whose percentile rank scores on the Raven Test of Progressive Matrices ranged from the 25th to 75th percentile, were selected as subjects. To each child five test situations, each containing 24 familiar toy objects, pictures of these toys, and word names of the toys were presented. They were instructed to group materials on the basis of similarity.

The data presented reveal a decrease with age in perceptual classification of items. This decrease between the ages of 7 and 9 years was significant, but not between 9 and 11, when children were asked to reduce groupings. The use of conceptual classifications increased steadily with age. Placement of items in miscellaneous categories was negatively correlated with age when the children were allowed free choice in grouping, but when urged to reduce the number of groupings, an age trend was not found.

Seven-year-old children principally used groupings of the thematic type in their first trials and repeated that approach when requested to reduce the number of groupings.

Nine-year-old children tended to use conceptual and perceptual classifications equally and made some use of the miscellaneous categories as well. When requested to reduce the number of groupings, they increased perceptual and miscellaneous classifications and reduced conceptual groupings.

Eleven-year-old children employed conceptual groupings predominantly but used the perceptual approach about as frequently as did nine-year-old youngsters. Miscellaneous classifications were infrequent when grouping was spontaneous. With pressure to reduce the number of groupings, conceptual and perceptual classifications still were used, but recourse to the miscellaneous category increased.

When groupings of the objects were made by the experimenter, the chidren's effort to identify the bases he had in mind did not reveal essentially different patterns of thought than did the groupings made by the children themselves.

REFERENCES

1. BOLLES, MARY MARJORIE. The basis of pertinence: A study of the test performance of aments, dements, and normal children of the same mental age. *Arch. Psychol., N.Y.*, 1937, No. 212.
2. BRIAN, CLARA H., and GOODENOUGH, FLORENCE L. The relative potency of color and form perception at various ages. *J. exp. Psychol.*, 1929, 12, 197-213.
3. COLBY, MARTHA G., and ROBERTSON, JEAN B. Genetic studies in abstraction. *J. comp. Psychol.*, 1942, 33, 385-401.
4. EDWARDS, A. L. *Experimental design in psychological research*. New York: Rinehart, 1950.
5. FEIFEL, H., and LORGE, I. Qualitative differences in the vocabulary responses of children. *J. educ. Psychol.*, 1950, 41, 1-18.
6. GOLDSTEIN, K. *The organism*. New York: American Book Co., 1939.
7. GOLDSTEIN, K., and SCHEERER, M. Abstract and concrete behavior: An experimental study with special tests. *Psychol. Monogr.*, 1941, 53, No. 2.
8. HEBB, O. *The organization of behavior*. New York: Wiley & Sons, 1949.
9. HEIDBREDER, EDNA. The attainment of concepts: A psychological interpretation. *Trans. N.Y. Acad. Sci.*, 1945, 7, 178-188.
10. HUMPHREY, G. The problem of generalization. *Bull. Canad. Psychol. Assn.*, 1944, 4, 37-51.
11. JOHNSON, B. The development of thought. *Child Develpm.*, 1938, 9, 1-7.
12. KOFFKA, K. *The growth of the mind: An introduction to child psychology*. Trans. Ogden. 2nd ed. rev. New York: Harcourt, Brace, 1928.
13. LING, BING-CHUNG. Form discrimination as a learning cue in infants. *Comp. Psychol. Monogr.*, 1947, 27, No. 2.
14. McNEMAR, Q. *Psychological statistics*. New York: Wiley & Sons, 1949.
15. PROTHERO, E. T. Egocentricity and abstraction in children and aments. *Amer. J. Psychol.*, 1943, 56, 66-77.
16. RIMOLDI, H. A study in some factors related to intelligence. *Psychometrika*, 1948, 13, 27-46.
17. SIGEL, I. E. Developmental trends in abstraction ability in children. Unpublished Ph.D. dissertation, Univ. Chicago, 1951.

18. Sigel, I. E. Dominance of meaning. *J. genet. Psychol.* In press.

19. Thompson, Jane. Ability of children on different grade levels to generalize on sorting tests. *J. Psychol.,* 1941, 11, 119-126.

20. Warren, H. C. *Dictionary of psychology.* Boston: Houghton Mifflin, 1934.

21. Weigle, E. On the so-called processes of abstraction. *J. abnorm. soc. Psychol.,* 1941, 36, 3-33.

22. Welch, L., and Davies, H. I. The theory of abstraction and its applications. *Psyche,* 1935, 15, 138-145.

23. Welch, L. A preliminary investigation of some aspects of the hierarchical development of concepts. *J. genet. Psychol.,* 1940, 22, 359-378.

24. Welch, L. The genetic development of the associational structures of abstract thinking. *J. genet. Psychol.,* 1940, 56, 172-206.

25. Werner, H. The concept of rigidity: A critical evaluation. *Psychol. Rev.,* 1946, 53, 43-52.

26. Werner, H. *Comparative psychology of mental development* (rev. ed.). Chicago: Follet Publishing Co., 1948.

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CONVERGENCE: AN ACCELERATED LONGITUDINAL APPROACH

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The problems involved in cross-sectional and longitudinal studies suggest the desirability of emphasizing the need for more extensive use of a third method. Essential features of this method are discussed in this article.

THE LONGITUDINAL APPROACH

Despite the many well-known advantages of the longitudinal approach, which have been described by Anderson (2) and others, Jones and Bayley (4) have pointed out that very few research centers are making a systematic use of this approach in studies of human development. The difficulty of financing and managing such projects engenders much hesitancy in both the investigators considering the task and the prospective supporting foundation or agency. The investigators need to consider carefully whether their own life plans are compatible with the experimental plan since cooperation of the group studied is difficult to maintain with frequent shifts in personnel. The large expenditure involved leads to prolonged negotiations and extensive planning periods. In addition, the magnitude of the expenditure may result in a tendency of the investigators to attempt to gather entirely too much data. This compulsion to collect measurements on all possible variables could be a function of the feeling that later results may turn up promising leads for which necessary substantiating data were not gathered in earlier periods. It may also emanate from a feeling that for such expenditures of money and effort only complete comprehensiveness is acceptable. Such a view would be consistent with a belief in the importance of basic data accumulation at a given phase in the development of a field. In any event, theory construction and precise testing of hypotheses are less frequent than data amassing operations.

In addition to the above problems, long-term longitudinal studies present many methodological difficulties which restrict their utility. The necessary sampling selection involved in restricting a study to cooperative groups limits generalization of findings as Anastasi and Foley point out (1, p. 268). It must be considered also that sampling errors made in the original selection are perpetuated in the continuing study, except to the extent that loss of cases due to death, migration, and other factors, changes the fundamental characteristics of the original sample still further. Another problem is that the repeated contacts and measurements necessary in some projects may lead to concern that the observation has itself introduced important changes

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in the orientation and motivation of the subjects. This seems less important in an area such as the study of growth curves, for example, than in a field such as child rearing practices. Still further complications arise from the fact that new and improved measurement techniques as well as important new variables may appear which cannot well be incorporated in the experimental plan. In short, it is apparent that the longitudinal approach is not the method par excellence for studying human development. A longitudinal approach should be selected, as any other method, on the basis of its appropriateness to the problem at hand. The problem is when to apply the longitudinal method, rather than how to marshal the courage to face the task.

The Cross-Sectional Approach

The cross-sectional approach offers certain advantages over the longitudinal, where contamination due to repeated observation is a matter of concern. At the same time, measurement techniques and variables to be studied are adjusted to the current level of scientific development. The investigator may feel more inclined to measure a few variables precisely or test definite hypotheses. Results from this type of study suggest new hypotheses which can be tested in further studies adequately designed for the purpose. Thus the development of a theoretical model in the area concerned moves much more rapidly than would be the case in a longitudinal approach in which the hypotheses are developed over a long period of time and cannot be tested adequately within the framework of the study as originally formulated. The possibility remains, in the case of cross-sectional approaches, that observed changes in age groups are a function of differences other than age between groups studied. The "dropping out" phenomenon, which makes successive school grade groups differ in representativeness of the basic age populations in the sampling universe, frequently seems adequate to account both for the direction and extent of changes observed in cross-sectional studies. In other cases, as Kuhlen (5) has pointed out, social change creates different experiential backgrounds for different age groups.

In any study where the cumulative effect of an independent variable on an individual is desired, a longitudinal approach must be used. For example, if one were to study long-term effects of annual guidance and counseling for school children, a cross-sectional approach could not be used.

Acceleration of the Longitudinal Approach

It is the purpose of this paper to suggest more extensive use of a research technique other than the cross-sectional or longitudinal in order to deal with some of the shortcomings of both. To facilitate presentation of the technique, it will be referred to as a convergence approach. It involves combining the cross-sectional and longitudinal techniques in such a way that developmental changes for a long period may be estimated in a much shorter period. Cross-sectional studies are made of different age groups so spaced in age that remeasurement of the same groups after a period of time provides information on the nature of the changes occurring over the entire age period, as well as data which will permit an answer to the question of whether the shorter curves for each age span may reasonably be combined into a curve covering the entire age period.

For example, a study of changes in a dependent variable such as synonym usage in children's word definitions over a four-year period may be accomplished by measuring each of two age groups three times over a two-year period. Age groups such as eight- and ten-year-olds would be selected so that the final measurement of the eight-year-olds is made at the same age as the initial measurement of the ten-year-olds. If the changes in frequency within each group showed continuity with the changes in the other group, and the frequency at age ten was essentially the same for both groups, the change in usage from the initial measurement of the eight-year-olds to the final measurement of the ten-year-olds could be defended as representative of a curve which would have been obtained had a single group been measured over a time span of four years.

The utility of the principle underlying this technique has been pointed out by Kuhlen (5). Miles (6) was able to show that sampling differences alone could not account for a decline in intelligence test scores shown in a cross-sectional study of four different age groups. A similar decline was revealed in remeasurement of the original age groups.

Application to single variable studies. An illustration of an application of this approach to a study of a single variable over a relatively long time period may be provided by assuming that an investigator wishes to study changes in variable X for children age six to fourteen. The curve plotted with triangular points in Figure 1 might be considered the "true curve" for the entire age period. Measurement of the dependent variable in year one of the study for children in the age groups six, eight, ten, and twelve (groups A, B, C, and D), followed by the remeasurement of the same groups in years two and three, would yield twelve points on the over-all curve, three for each age group. Plotting of these points on the same graph would possibly indicate that the slopes of the lines connecting points within adjacent age groups were essentially equivalent. This is illustrated by the curve shown for example I, plotted with open circle points.

If separate curves as shown for example II were obtained, the investigator might have reason to question the hypothesis that each age group was a sample of the same basic population universe, subject to age change only. In effect, within a two-year period with three measurements on each age group, the investigator would be attempting to construct a curve for an eight-year period.

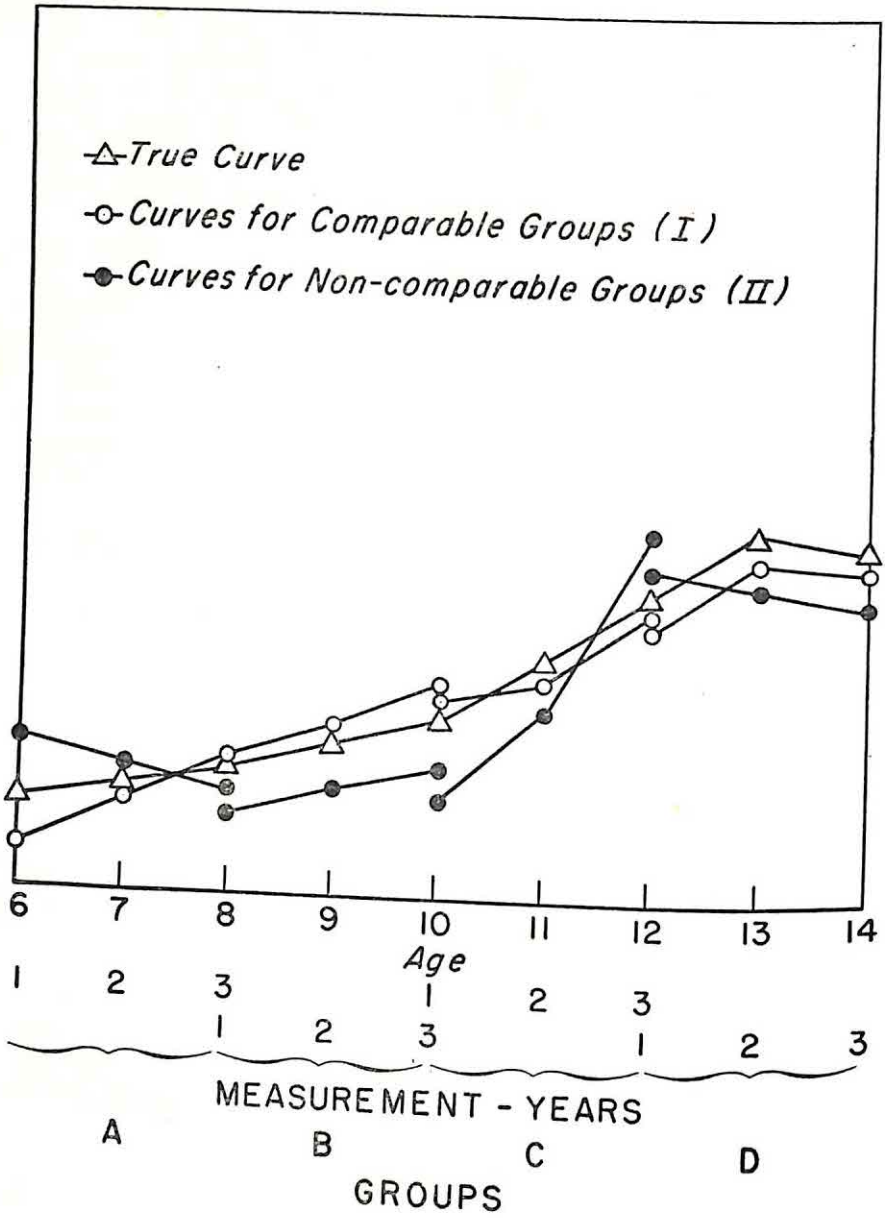

FIGURE 1—Hypothetical Growth Curves for Comparable and Non-Comparable Groups

In the case of example I, the investigator might well argue for the essential comparability of his age group sampling. It is more likely that group B had a curve between six and eight similar to group A than would have been the case had the two groups at age eight been moving either in different directions or were at different levels, as is the case of example II.

The two age groups A and B in example I have converged statistically. This convergence would favor the notion that the groups are comparable for the purpose at hand, and the investigator has some support for the operation of linking the curves. In so doing he is considering the measurements of groups A and B as representative of those which would be yielded by a single group over a four-year period.

Significance tests may be applied to the difference between group A and B means at age eight. Evaluation of direction of movement is more difficult. A forward extrapolation of group A means is to be compared with the curve defined by group B means, and a backward extrapolation of group B means is to be compared with a curve defined by group A means. The writer is not aware of any technique which could be used here other than inspection, unless group A, for example, were to be measured again at age nine so as to overlap with two measurements on group B. In the latter case an application of analysis of variance would seem appropriate to test the significance of the difference between the means of the two groups on two different measurements.

It is most likely that the evaluation of direction of movement would have precedence over comparability with respect to levels in determining whether the curves should be linked. Thus the fact that there might be a significant difference between group A and B means at age eight in example II of Figure 1 would carry less weight than the difference in direction of the two group curves. If group A and B means at age eight were identical and these were the only measurements available, the possibility might exist that the two groups reached this level from two quite different preceding curves. The possibility remains that the difference in direction of movement for the two groups is an evidence of discontinuity in the basic developmental variable rather than evidence of non-comparability of the two groups. In this example, however, the difference in levels might suggest sampling variation. If there were only a difference in direction of movement, the discontinuity hypothesis would be more tenable. In such a case a new study in which seven- and nine-year-olds are used as groups A and B would remove the curve-linking problem from the temporal vicinity of the suspected discontinuity.

Application to multiple variable studies. If several variables were to be studied in the investigation and measured in comparable units, the problem of determining whether measurements for adjacent groups should be linked is partially a question of whether the profiles for the two groups at the same age are similar in shape and level. This question of similar shapes can be answered by an analysis of variance test as advocated by Block *et al.* (3). The question of differences in level is the usual analysis of variance test for the significance of differences between groups on two or more

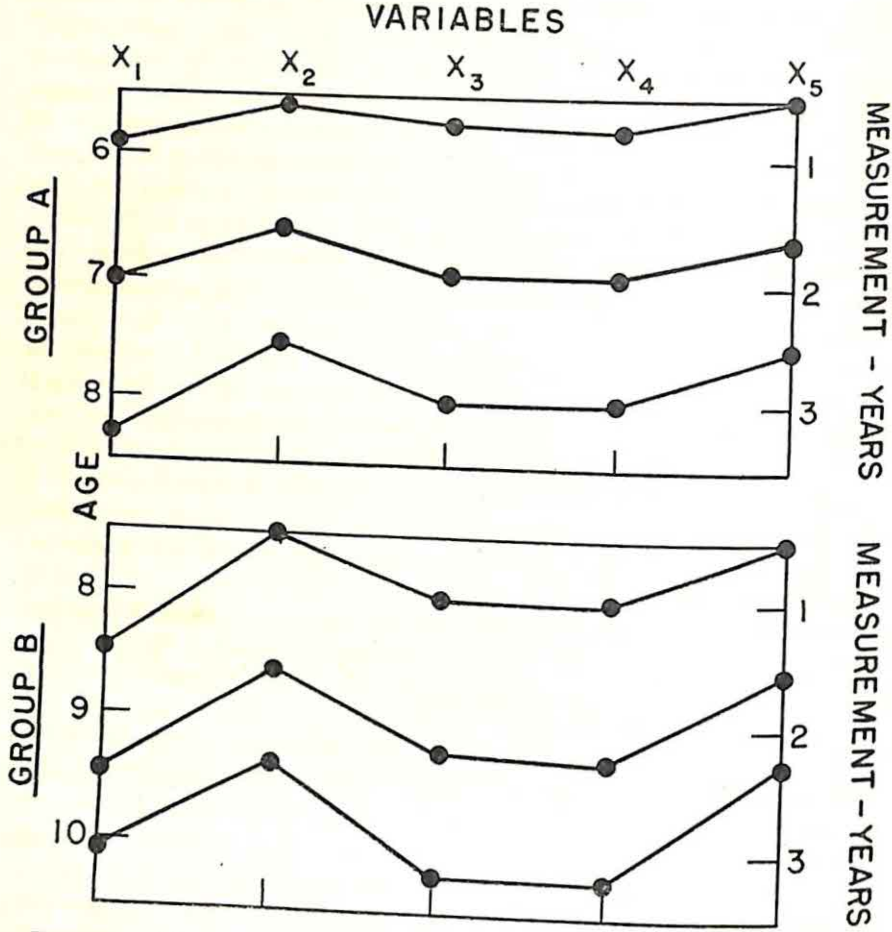

Figure 2—Hypothetical Profile Changes in Two Comparable Groups

measures. Again, the question of direction of movement would have to be dealt with either by inspection or creating overlapping measurements as indicated above for the single variable problem. Figure 2 is an attempt to represent a situation in which such evaluations would be involved. Variables $x_1 \ldots x_5$ are measured in standard score units in year one, two, and three, starting at age six in group A and age eight in group B. In this case the question is, in part, whether the profile of group A at age eight is significantly different in level and shape from the profile of group B at the same age. Comparability of the groups in this multivariate situation should give the investigator more confidence in the operation of linking curves than in the situation where only one variable is measured.

Average and individual curves. The illustrations given above assume essentially homogeneous groups. Such an assumption is frequently unwar-

, as has been shown in instances where individual growth curves have compared with group curves (7). It should be noted that repeated measurements of the same individuals in a longitudinal or convergence study offer a basis for identifying sub-groups within which developmental changes are relatively homogeneous. In cross-sectional studies there is no basis for identifying sub-groups of individuals whose measurements change essentially the same manner with the passage of time. The fact that such sub-groups must be relatively large for their measurements to be stable requires that the parent group be quite large. Where these conditions can be met it would seem desirable in either a longitudinal or convergence study to attempt to link measurements of sub-groups rather than parent groups. Group A in the example of Figure 1 may actually be composed of sub-groups $A_1 \ldots A_n$ which could be linked developmentally with certain of the sub-groups $B_1 \ldots B_n$. The behavior of such sub-groups may be much more important than changes in the composite group.

The purpose of the above discussion has been to illustrate the essential elements of the convergence approach. Detailed consideration of statistical problems involved in specific applications is not appropriate in this context. Measurement issues such as the problems of difficulty range and equality of units will not be discussed since they are involved in all three types of developmental studies.

SUMMARY

The convergence approach appears to have greatest utility in two types of situations: (*a*) in investigations basically oriented toward a cross-sectional approach but in which there is reason for concern over the comparability of the experimental groups relative to the dependent variable on factors other than age, and in which it is possible to make limited remeasurements of these groups; (*b*) for investigations oriented toward the longitudinal approach but faced with problems of transient or less cooperative groups or with possibilities of undesirable contamination of the experimental population by extensive observation.

It is expected that the desire to anticipate long-term trends as early as possible and the need to incorporate current research developments would favor use of the cross-sectional and convergence approaches. The desire to follow individual changes, when reformulated as a desire to identify and follow statistically meaningful sub-groups, does not preclude use of the convergence approach. If the cumulative effect of an independent variable on a single individual is to be studied, however, the convergence and cross-sectional approaches cannot be used.

REFERENCES

1. ANASTASI, ANNE, and FOLEY, J. P. *Differential psychology.* New York: Macmillan, 1949.

2. Anderson, J. E. Methods of child psychology. In L. Carmichael, *Manual of child psychology,* New York: John Wiley, 1946.

3. Block, J., Levine, L., and McNemar, Q. Testing for the existence of psychometric patterns. *J. abnorm. soc. Psychol.* In press.

4. Jones, H. E. and Bayley, Nancy. Growth, development, and decline. In C. P. Stone and D. W. Taylor, *Annual review of psychology.* Stanford, Calif.: Annual Reviews, 1950.

5. Kuhlen, R. G. Social Change: A neglected factor in psychological studies of the life span. *Sch. & Soc.,* 1940, 52, 14-16.

6. Miles, C. C. Influence of speed and age on intelligence scores of adults. *J. gen. Psychol.,* 1934, 10, 208-210.

7. Shuttleworth, F. K. Sexual maturation and the physical growth of girls age six to nineteen. *Monogr. Soc. Res. Child Develpm.,* 1937, 2, No. 5, 32-33.

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ERRATA

THE SEX DIFFERENCE IN THE BASAL METABOLIC RATE

Figures 1 and 2 on pages 218 and 219 should be reversed to match the captions.

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"REAL-LIFE" MEASURES OF LEVEL OF ACADEMIC AND VOCATIONAL ASPIRATION IN ADOLESCENTS: RELATION TO LABORATORY MEASURES AND TO ADJUSTMENT[1]

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The Problem

Since academic and vocational aspirations constitute a highly significant aspect of adolescent goal structure and adjustment, it is important to test the feasibility and predictive usefulness of "real-life" measures of these variables that would be comparable to laboratory measures of level of aspiration. Do such measures have any generality? Are they meaningfully related to indices of adjustment? What relationship do they bear to laboratory measures of aspiration level?

Various investigators have utilized such measures of vocational aspiration as estimate of future income (21, 30), job-prestige level of vocational choice and preference (20, 23), and estimate of past performance in a training situation (18). C. H. Smith (27) measured level of striving in a context of athletic competition. Child and Whiting were concerned with retrospective aspirational responses to every-day experiences of success and failure in the life histories of their subjects (7). The usefulness and the functional relationship of these indices to the more traditional laboratory measures were found to vary considerably. In the present study, a continuum of aspirational measures was employed ranging from concrete and immediate laboratory tasks to more abstract and remote vocational strivings, with academic aspirations and aspirational responses to hypothetical vocational situations occupying an intermediate position.

Method

Population

The subjects in this study consisted of 50 students, comprising (with the exception of a few absentees) the entire junior class of University High School[2] in Urbana, Illinois. The mean age of these students was 15.8 years.

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[2] The authors are grateful to Professor C. M. Allen, principal, and to the staff of the University High School, University of Illinois, for their cooperation and administrative assistance in the collection of data for this study.

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The distribution by sex was 24 boys and 26 girls. Most of the students come from professional homes, the parents generally holding academic appointments at the University of Illinois.

"Real-Life" Measures of Level of Academic and Vocational Aspiration

Two measures of level of academic aspiration were used: (*a*) *academic goal discrepancy*—the algebraic difference between the student's expressed academic aspirations for the current year and his grade point average for the preceding four semesters; and (*b*) *academic performance estimate*—the algebraic difference between the student's estimate of his cumulative high school standing and his four-semester grade point average. Estimate of high school standing was made on a six point scale ("well below average" to "upper few"), and academic aspiration was expressed in terms of a five point scale ("get by" to "upper few"). Grade point average was computed on a five point scale from actual grades, which in this school are officially recorded but not made known to students.

Three measures of level of vocational aspiration were employed: (*a*) *vocational unreality*—the total discrepancy between each of a subject's nine subscale percentile scores on the Kuder Preference Record (19) and the corresponding mean percentile scores of persons in his occupation of choice as given in the manual for this test; (*b*) *vocational prestige needs*—the student's total weighted score on the level of interests part of the Lee-Thorpe Occupational Interest Inventory[3] (20); (*c*) *vocational tenacity*—a composite standard score on a hypothetical level of aspiration test consisting of three hypothetical situations in which the subject is successively asked to imagine that he is preparing for careers in medicine, engineering, and a skilled trade respectively, and that in the course of his studies he meets serious obstacles of a designated nature. In each situation four alternatives are presented ranging from maintenance of the original goal at all costs (high vocational tenacity) to complete abandonment of the original vocational goal (low vocational tenacity). The subject's choice in each situation, approximately weighted, is converted into a standard score, and all three standard scores are added to yield a composite score.

Laboratory Measures of Level of Aspiration

Five types of laboratory measures of level of aspiration were obtained: (*a*) *composite goal discrepancy*—a total goal discrepancy score derived by adding algebraically the subject's mean goal discrepancy score on each of three paper-and-pencil level of aspiration tests. The mean score for each test is itself an algebraic mean of S's four goal discrepancies calculated in the usual fashion by subtracting reported score on a given trial from level of aspiration for the immediately succeeding trial. In computing the composite goal discrepancy score, S's mean score for each type of material is first divided by the standard deviation for the entire population. (*b*) *maze goal discrepancy*—the subject's mean goal discrepancy on five trials of a "rigged" stylus maze test. (*c*) *composite goal tenacity*—comparable to the composite goal discrepancy score described above, except that goal tenacity scores are used. Goal tenacity scores are derived by subtracting from each goal discrepancy score the preceding attainment discrepancy. Since the attainment discrepancy (performance on a given trial minus the preceding level of aspiration) is a measure of the feelings of success or failure attending performance (22), the goal tenacity score represents the relative propensity of an individual to maintain a high level of aspiration in relation to prior success or failure experiences. (*d*) *maze goal tenacity*—comparable to composite goal tenacity, except that scores are derived from the "rigged" stylus maze test. (*e*) *initial performance estimate*— a composite discrepancy score on the three paper-and-pencil level of aspiration tests in which S's performance on the first trial is in each case subtracted from his level of aspiration for same. It is a measure of S's degree of optimism relative to future task performance when he has no precise reference point in immediate prior experience to use as a basis for estimating. In computing S's composite score, his scores on the separate test materials are also divided by their respective standard deviations for the entire population of subjects. In a previous study it had been ascertained that goal discrepancy and goal tenacity scores enjoyed relatively high split-half reliabilities and considerable generality over these test materials (2).

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[3] In this test, the subject is presented with thirty triads of occupational activities in each of which area of work involved is held relatively constant while level of job prestige is varied. Total score is computed from the subject's preferences in each triad appropriately weighted in terms of job prestige.

Speed of reading (Michigan Speed of Reading Test), speed of addition and subtraction, and speed of digit-symbol substitution were the three types of paper-and-pencil materials used. In each test, the subject makes an initial prediction of performance prior to the first trial and four subsequent predictions following each of the four trials. A trial is defined as a timed interval (60 or 90 seconds) in which S tries to complete as many test units of uniform difficulty as he possibly can.

The "rigged" stylus maze test consists of four "blindfold" trials of an irregular twelve-turn stylus maze. Bogus percentile scores are reported to the subject, and predictions are also made in terms of percentiles. To insure uniform and cumulative experiences of failure for the entire group, the bogus score reported to the subject in a given trial is always a prearranged percentage of expressed level of aspiration (75 per cent for the first trial, and 70 per cent for the next three trials).

To secure ego-involvement in the paper-and-pencil tests, tasks with academic connotations were chosen, and their relevance for academic and vocational success were explicitly pointed out. The stylus maze test was presented as a measure of learning ability in which the subject's performance was to be related to a group norm.

Measures of Adjustment

The following measures of adjustment level were utilized: (*a*) *teacher's adjustment rating*—the mean adjustment rating given by five current teachers of each S on a one to five scale. This is a rating of general personality adjustment and was not restricted to the school situation. (*b*) *anxiety score*—total score on a paper-and-pencil inventory designed to measure anxiety level (Illinois Personality Inventory). (*c*) *sociometric status*—the mean sociometric rating earned by each student when rated sociometrically by all of his classmates on a five point scale. (*d*) *M.M.P.I. adjustment score*—total adjustment score on the Minnesota Multiphasic Personality Inventory (13). In deriving total adjustment scores, raw scores of subjects on each of the subscales are first converted into standard scores. Since a positive standard score on a given subscale indicates a degree of deviancy with respect to the trait measured that is greater than the mean characterizing our population, a measure of total personality deviancy is obtained for each subject by summing all of his positive standard scores on the various

TABLE I

MEANS AND STANDARD DEVIATIONS OF "REAL-LIFE" AND LABORATORY MEASURES OF LEVEL OF ASPIRATION BY SEX GROUPS

	MEAN			STAND. DEVIATION		
Measure	*Boys*	*Girls*	*Significance Level of Difference*	*Boys*	*Girls*	*Significance Level of Difference*
"Real-Life"						
Academic Goal Discrepancy	1.1	1.6	$p>.05$	0.7	1.4	$.05>p>.01$
Academic Performance Estimate	—0.1	+0.7	$p<.01$	0.1	0.2	$p>.05$
Vocational Unreality	9.0	8.6	$p>.05$	2.2	2.8	$p>.05$
Vocational Prestige Needs	62.1	58.4	$p>.05$	5.0	12.4	$p<.01$
Vocational Tenacity	11.4	7.5	$p<.01$	1.9	3.4	$.05>p>.01$
Laboratory						
Composite Goal Discrepancy	—0.5	—1.9	$p>.05$	4.1	3.2	$p>.05$
Composite Goal Tenacity	—0.8	—2.2	$p>.05$	3.2	4.0	$p>.05$
Maze Goal Discrepancy	8.3	7.8	$p>.05$	11.6	12.7	$p>.05$
Maze Goal Tenacity	41.9	43.5	$p>.05$	20.4	24.4	$p>.05$
Initial Performance Estimate	—2.6	—3.6	$p>.05$	3.2	1.7	$p<.01$

subscales.[4] A high total score, therefore, is indicative of relatively poor adjustment.

RESULTS

Table 1 gives separately by sex the means and standard deviations of raw scores on the "real-life" and laboratory measures of level of aspiration. A surprising finding was the significantly greater tendency on the part of girls ($p<.01$) to overestimate their grade point average. The only other significant sex difference between means was in vocational tenacity. As anticipated, boys showed greater vocational tenacity ($p<.01$). Girls were significantly more variable than boys with respect to academic goal discrepancy, vocational prestige needs, vocational tenacity, and initial performance estimate.

TABLE 2

INTERCORRELATIONS AMONG "REAL-LIFE" MEASURES OF LEVEL OF ASPIRATION

Measure	Academic Performance Estimate		Vocational Unreality		Vocational Prestige Needs		Vocational Tenacity	
	Boys	*Girls*	*Boys*	*Girls*	*Boys*	*Girls*	*Boys*	*Girls*
Academic Goal Discrepancy ...	**.60	**.87	—.21	—.34	—.22	.06	.10	—.11
Academic Performance Estimate	....	....	—.31	—.11	—.25	—.03	.09	.14
Vocational Unreality	....	....	....	....	**.60	.22	.03	.02
Vocational Prestige Needs	....	....	....	....	....	....	*.44	.08

** Designates significant at the .01 level of confidence.
* Designates significant at the .05 level of confidence.

The reliability (test-retest or split-half) of academic goal discrepancy and academic performance estimate scores could not be ascertained; but considerable generality of function with respect to these two measures was reflected in the high correlation between them (see Table 2). Individuals who tended to overestimate past academic accomplishments also tended to have relatively high academic aspirations for the future in terms of past performance. Although academic standing is never officially revealed to students, many cues are apparently available for estimating same since the mean error of estimate of past academic performance was significantly better than chance far beyond the 1 per cent level of confidence.

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[4] Since a negative standard score is indicative of deviancy on the masculinity-femininity subscale, negative standard scores on this subscale are added to the other standard scores to obtain the total M.M.P.I. adjustment score.

No feasible method was available for determining the reliability of vocational unreality scores. The test-retest reliability coefficient of the level of interests scores on the Occupational Interest Inventory (identical with our measure of vocational prestige needs) is given as .88 in the test manual (20). Contingency coefficients were calculated between the separate scores on the three parts of the vocational tenacity test. C for physician and engineer was .56 ($p < .01$); for engineer and skilled trade, C was .25 ($p = .03$); and for physician and skilled trade C was —.30 ($p = .02$). Generality of vocational tenacity, therefore, is a function of degree of similarity between occupations on which this measure is obtained. Vocational tenacity in a given hypothetical situation was not enhanced if the subject's actual vocational choice happened to coincide with the goal of the particular hypothetical situation. For example, boys who wanted to be engineers did not make a higher vocational tenacity score on the engineering part of this test than boys who did not express this vocational ambition.

TABLE 3

CORRELATIONS BETWEEN "REAL-LIFE" MEASURES OF LEVEL OF ASPIRATION AND RELATED TEACHERS' RATINGS

	TEACHERS' RATINGS					
	SCHOLASTIC COMPETITIVENESS		PERSISTENCE		ACADEMIC ASPIRATIONS	
"Real-Life" Measures of Level of Aspiration	*Boys*	*Girls*	*Boys*	*Girls*	*Boys*	*Girls*
Academic Goal Discrepancy ...	*—.52	**—.57	*—.57	**—.59	—.30	*—.44
Academic Performance Estimate	—.38	*—.48	—.20	*—.43	—.15	—.31
Vocational Unreality	—.08	.27	—.13	.37	—.03	.33
Vocational Prestige Needs	.31	.23	.16	.11	.35	.25
Vocational Tenacity	.22	*.45	—.04	—.15	.34	.37

** Designates significant at the .01 level of confidence.
* Designates significant at the .05 level of confidence.

As shown in Table 2, scores on vocational prestige needs were significantly related to both vocational unreality and vocational tenacity in boys. Without exception, academic and vocational measures of level of aspiration were not significantly related.

A very surprising finding was a pronounced tendency for academic goal discrepancy scores (presumably indicative of level of academic aspiration) to correlate negatively with such highly related teachers' ratings as "scholastic competitiveness," "persistence," and "academic aspirations." In other words, students who expressed high academic aspirations tended to be judged by teachers as relatively non-competitive, as possessing low academic

TABLE 4

RELIABILITY OF TEACHERS' RATINGS OF VARIOUS ASPIRATIONAL TRAITS

Aspirational Trait	*Mean Intercorrelation*† *between Ratings of Five Teachers*
Scholastic Competitiveness	**.50
Academic Aspiration	**.64
Persistence	**.57

† Mean intercorrelations were calculated by the "squared r" method.

** Designates significant at the .01 level of confidence.

aspirations, and as non-persistent in their strivings. The same negative relationship prevailed with respect to academic performance estimate, but was statistically significant in only two of the six instances (see Table 3). In general, the relationships between teachers' ratings and measures of vocational aspiration were not statistically significant and revealed no consistent trend. The teachers' ratings themselves showed a fair amount of reliability (generality over raters) (see Table 4), and considerable generality over traits (see Table 5). Some of this latter generality might in part be a function of "halo effect," but much of it must undoubtedly reflect logical similarity between traits. Table 5 shows that the three motivational traits are more closely related to each other than any of them is to teachers' rating of adjustment.

Laboratory and "real-life" measures of level of aspiration were not significantly related to each other. No consistent pattern of relationships was apparent, and no coefficient of correlation reached the 5 per cent level of confidence when scores were intercorrelated separately for boys and girls.

TABLE 5

INTERCORRELATIONS AMONG PERSONALITY TRAITS AS RATED BY TEACHERS

Personality Trait	*Scholastic Competitiveness*	*Academic Aspiration*	*Persistence*
General Adjustment	**.60	**.42	**.71
Scholastic Competitiveness	....	**.79	**.81
Academic Aspiration	....	....	**.73

** Designates significant at the .01 level of confidence.

TABLE 6

CORRELATIONS BETWEEN "REAL-LIFE" MEASURES OF ASPIRATION AND VARIOUS MEASURES OF ADJUSTMENT

"Real-Life" Measures of Level of Aspiration	Teachers' Rating of Adjustment		Anxiety Level (I. P. I.)		Sociometric Status	
	Boys	*Girls*	*Boys*	*Girls*	*Boys*	*Girls*
Academic Goal Discrepancy	*—.43	*—.49	**.63	.30	—.09	*—.51
Academic Performance Estimate	—.20	*—.46	*.42	.17	—.11	*—.42
Vocational Unreality	—.31	—.22	—.30	—.27	—.16	—.11
Vocational Prestige Needs	—.25	—.10	—.28	.34	—.16	.09
Vocational Tenacity	—.11	.19	.25	.12	.21	.25

** Designates significant at the .01 level of confidence.
* Designates significant at the .05 level of confidence.

High academic goal discrepancy scores (and to a lesser extent academic performance estimate scores) were negatively related to teachers' rating of adjustment in both boys and girls, and to sociometric status in girls (see Table 6). In boys these same measures of level of academic aspiration were positively correlated with anxiety level. Vocational measures of level of aspiration were not significantly related to measures of adjustment. No significant correlations were obtained between M.M.P.I. adjustment scores and any of the "real-life" measures. The split-half reliability coefficients of the anxiety scores and the sociometric status scores were .94 and .90 respectively. The mean intercorrelation[5] between five teachers' ratings of adjustment was .64.

To test the possibility that significant relationships between adjustment scores and "real-life" measures may have been obscured in the correlational analysis as a result of the frequently reported tendency for *both* high positive and high negative aspirational scores to be associated with poor adjustment (4, 11, 26), a chi-square test was performed in each case. Upper and lower adjustment groups on each criterion of adjustment were tabulated in relation to upper, middle, and lower thirds of the frequency distributions of the "real-life" measures. Significant values of chi-square were (with only one exception) obtained in only those instances in which significant correlations are shown in Table 6. Inspection of the chi-square tables revealed that the better adjusted (or less anxiety-ridden) subjects tended to make low scores on the aspirational variables in question and *vice versa*. The one exception in which a significant value of chi-square ($p = .01$) accompanied a non-significant r between the two variables occurred in the case of academic goal discrepancy and M.M.P.I. adjustment scores. Here the majority of the more poorly adjusted individuals obtained goal discrepancy scores in the middle range of the distribution, whereas the majority of the better adjusted subjects obtained low discrepancy scores.

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[5] The mean intercorrelation was obtained by the "squared r" method.

DISCUSSION

The absence of sex differences in favor of boys with respect to mean scores on laboratory and "real-life" measures of level of aspiration (except for the higher mean score of boys on vocational tenacity) goes against the general trend of previous findings (24, 29, 31). It can be accounted for perhaps by the high socio-economic status of our subjects. The vocational interest patterns of girls are in no sense inappropriate for traditionally masculine occupations (6); and girls from upper socio-economic groups are encouraged at the secondary and undergraduate levels of instruction to think in terms of academic and vocational aspirations that are commensurate with those of boys. In Holt's study, Radcliffe women actually made higher goal-discrepancy scores than Harvard men (17). That greater heterogeneity exists in the aspirational patterns of girls—suggestive of greater diversity in cultural expectations—is evident from significantly greater variability in the academic goal discrepancy, vocational prestige needs, vocational tenacity, and initial performance estimate scores of our subjects. Very significantly also, girls manifest less mean vocational tenacity when they are confronted with serious obstructions to hypothetical goals. It can be defensibly argued that their culture permits them to retire more gracefully from the field—with less loss of self-esteem—under adverse conditions of goal striving.

Measures of academic aspirations were found to have generality from past to future estimates as indicated by the high correlation between academic goal discrepancy and academic performance estimate. Hilgard and Sait (16) also found high correlations between discrepancy scores involving estimates of completed and future laboratory tasks respectively. Paradoxically, measures of academic aspiration were negatively related to teachers' judgments of closely related traits. The difficulty of judging aspirational level of others, however, should not be underestimated. Gardner (9) found no significant relationships between laboratory measures of aspiration and eight related personality traits. Ausubel (1) obtained an r of $-.09$ between pupils' self ratings and teachers' ratings on aspirational traits. In view of the notoriously poor insight of teachers into adolescents' interests (5) and strivings, "real-life" measures of aspirational level are presumably a more valid measure of motivational status than the ratings of teachers who do not happen to be intimately acquainted with the personality structure and development of their pupils.

The test of vocational prestige needs is based on the assumption that by the time individuals reach the age of adolescence they manifest characteristic and stable needs for a given range of occupational prestige. This assumption is supported in part by the high test-retest reliability which this test enjoys (20). Generality on the vocational tenacity test is a function of degree of similarity between occupations. This finding is in accord with the results of previous investigations on level of aspiration for laboratory tasks (2, 14). The measure of vocational unreality is based on the premise that it is unrealistic for individuals to aspire to a given vocation unless they have interest patterns similar to those of persons already employed in their occupation of choice. Insofar as it has been shown that systematic and logically predictable differences exist in the interest patterns of different vocational groups (19, 28), and that the appropriateness of an individual's interest pattern is related to occupational success and contentment (28), this assumption is quite defensible. Supportive evidence for this interpretation is also found in the moderately high correlation obtained in this study between vocational unreality and vocational prestige needs in boys. High needs for prestige may understandably influence an individual to ignore the fact that his interest patterns are inappropriate for the occupation to which he aspires. They would also tend to increase his vocational tenacity (see Table 2).

In contrast to previous findings that *both* high positive and high negative discrepancy scores on laboratory measures are associated with poor adjustment (4, 11, 26), high academic aspirations were found to be inversely related to adjustment in both sexes, directly related to anxiety level in boys, and inversely related to sociometric status in girls. Hence, with respect to long-range, "real-life" goals, only high aspirations have negative implications for adjustment, whereas low aspirations tend to have favorable implications. The finding that high anxiety is associated with high levels of aspiration confirms the results of previous investigations with laboratory measures (3, 8, 12). The sex differences are in the expected direction. The failure of vocational measures of aspiration to correlate significantly with indices of adjustment is attributed to the lack of imminence of vocational problems. In an actual vocational setting Klein (18) found that over-estimates of performance were negatively related to success in flying training.

The most difficult finding of all to explain has to do with the absence of relationship between laboratory and "real-life" measures of level of aspiration. One is tempted at first to accept Hilgard's view that this lack of relationship is a function of the relative triviality and the low degree of ego-involvement characterizing laboratory tasks (15). This could hardly be the entire explanation, however, since laboratory goal discrepancy scores have been found to possess considerable generality over trials within a task and between different tasks (2, 14, 16, 22). Additional evidence of the significance of laboratory measures of aspiration level for general personality structure comes from the findings that high and low goal discrepancy scores on laboratory tasks are associated with over- and underestimation respectively of own I.Q. (10) and of own sociometric status (25).

Hence, it might be more precise to state that both laboratory and "real-life" measures of level of aspiration can be characterized by ego-involvement, and that the apparent lack of relationship between them is a function of important differences relative to the centrality and reality stratum in which this ego-involvement operates. Laboratory tasks are obviously less threatening to self-esteem, and ego disinvolvement can be effected more easily in relation to them than in relation to "real-life" goals. They are also more immediate, more concrete, and more readily correctible by a tangible and realistic frame of reference in previous performance. "Real-life" aspirations, on the other hand, are relatively remote and hypothetical. Our culture encourages the young to aspire to grandiose and unrealistic goals. The distant future is not bound by the same reality considerations as the immediate present.

But when laboratory or "real-life" measures of level of aspiration are related to indices of adjustment under conditions in which the tasks have relevance for the *current* situation, e.g., academic goal discrepancy, significant relationships between aspirational measures and adjustment are found (see Table 6). Klein's (18) results, already referred to, support this finding. P. S. Sears (26) also found that laboratory measures of aspiration were significantly related to adjustment when the experimental tasks were important in the daily lives of her subjects. When both laboratory and "real-life" measures involve *current* situations at comparable strata of reality testing, e.g., estimates of I.Q., sociometric status, and of immediate performance on school tasks, the two kinds of measures are positively related (10, 25). This relationship is dramatically pointed up by C. H. Smith's finding that immediate but not ultimate level of aspiration in athletic competition is correlated with previous athletic performance (27).

Summary and Conclusions

"Real-life" measures of academic and vocational aspiration were obtained for a class of fifty juniors in a University high school, and related to laboratory measures of level of aspiration and to indices of general adjustment, anxiety level, and sociometric status.

Girls made significantly higher errors of estimate in judging past academic performance and showed significantly greater variability than boys on most "real-life" measures. Boys made significantly higher scores on a measure of vocational tenacity.

Estimates of past academic accomplishment were highly correlated with estimates of future academic performance. Both measures of academic aspiration, however, were negatively correlated with teachers' ratings of related traits. Scores on a test of vocational prestige needs were significantly related to measures of "vocational unreality" and vocational tenacity in boys. Generality on the vocational tenacity test was a function of degree of similarity between occupations. Academic and vocational measures were not significantly related to each other.

Measures of academic aspiration were negatively correlated with measures of general adjustment in both sexes and with sociometric status in girls. In boys, a significant positive correlation was obtained between magnitude of academic aspiration and anxiety level. Measures of vocational aspiration were not significantly related to indices of adjustment. The feasibility of their use in non-vocational settings is, therefore, questionable.

The obtained absence of significant relationships between "real-life" and laboratory measures of level of aspiration is attributed to greater centrality of ego-involvement in the former, and to differences in the relative corrective influence of reality considerations operating respectively in the immediate present and in the remote future.

REFERENCES

1. AUSUBEL, D. P. Prestige motivation of gifted children. *Genet. Psychol. Monogr.*, 1951, 43, 53-117.
2. AUSUBEL, D. P., and SCHIFF, H. M. A level of aspiration approach to the measurement of goal tenacity. *J. gen. Psychol.*, in press.
3. AUSUBEL, D. P., SCHIFF, H. M., and GOLDMAN, M. Qualitative characteristics in the learning process associated with anxiety. *J. abnorm. soc. Psychol.*, 1953, 48, 537-547.
4. AX, A. F. A validation study of the Rotter-Jensen level of aspiration test. *J. Pers.*, 1946, 15, 166-172.
5. BAKER, H. L. High-school teachers' knowledge of their pupils. *Sch. Rev.*, 1938, 46, 175-190.
6. CARTER, H. D., and STRONG, E. K. Sex difference in occupational interests of high-school students. *Personnel J.*, 1933, 12, 166-175.
7. CHILD, I. L., and WHITING, J. W. M. Determinants of level of aspiration: Evidence from everyday life. *J. abnorm. soc. Psychol.*, 1949, 44, 303-314.
8. EYSENCK, H. J. *Dimensions of Personality.* London: Kegan Paul, 1947.
9. GARDNER, J. W. The relation of certain personality variables to level of aspiration. *J. Psychol.*, 1940, 9, 191-206.
10. GILINSKY, A. S. Relative self-estimate and the level of aspiration. *J. exper. Psychol.*, 1949, 39, 256-259.

11. GRUEN, E. W. Level of aspiration in relation to personality factors in adolescence. *Child Develpm.*, 1945, 16, 181-188.

12. HARTOGS, R. The clinical investigation and differential measurement of anxiety. *Amer. J. Psychiat.*, 1950, 106, 929-934.

13. HATHAWAY, S. R., and MCKINLEY, J. C. *The Minnesota Multiphasic Personality Inventory.* Minneapolis: Univ. Minnesota Press, 1943.

14. HEATHERS, L. B. Factors producing generality in the level of aspiration. *J. exp. Psychol.*, 1942, 30, 392-406.

15. HILGARD, E. R. Success in relation to level of aspiration. *Sch. & Soc.*, 1942, 55, 423-428.

16. HILGARD, E. R., and SAIT, E. M. Estimates of past and of future performances as measures of aspiration. *Amer. J. Psychol.*, 1941, 54, 102-108.

17. HOLT, R. R. Level of aspiration: Ambition or defense. *J. exper. Psychol.*, 1946, 36, 398-416.

18. KLEIN, G. S. Self-appraisal of test performance as a vocational selection device. *Educ, psychol, Measmt.*, 1948, 8, 69-84.

19. KUDER, G. F. *Revised manual for the Kuder Preference Record.* Chicago: Science Research Associates, 1946.

20. LEE, E. A., and THORPE, L. P. *Occupational Interest Inventory, Advanced Form A.* Los Angeles: California Test Bureau, 1946.

21. LEVITT, E. E. Cognitive distortion and ego-involvement. *J. Pers.*, 1950, 19, 212-220.

22. LEWIN, K., DEMBO, T., FESTINGER, L., and SEARS, P. S. Level of aspiration. In J. McV. Hunt (Ed.)., *Personality and the Behavior Disorders.* New York: Ronald, 1944, Vol. 1, Pp. 333-378.

23. LURIE, W. A. Estimating the level of vocational aspiration. *J. soc. Psychol.*, 1939, 10, 467-473.

24. ROTTER, J. B. Level of aspiration as a method of studying personality: III. Group validity studies. *Charact. Pers.*, 1943, 11, 255-274.

25. SCHIFF, H. M. Personality correlates of judgmental response sets in the perception of sociometric status. Unpublished doctor's dissertation, Univ. of Illinois, 1953.

26. SEARS, P. S. Levels of aspiration in academically successful and unsuccessful children. *J. abnorm. soc. Psychol.*, 1940, 35, 498-536.

27. Smith, C. H. Influence of athletic success and failure on the level of aspiration. *Res. Quart. Amer. Assoc. Hlth.*, 1949, 20, 196-208.

28. Strong, E. K. *Vocational interests of men and women.* Stanford, Calif.: Stanford Univ. Press, 1943.

29. Sumner, F. C., and Johnson, E. E. Sex differences in levels of aspiration and in self-estimates of performance in a classroom situation. *J. Psychol.*, 1949., 27, 483-490.

30. Thomsen, A. Expectation in relation to achievement and happiness. *J. abnorm. soc. Psychol.*, 1943, 38, 58-73.

31. Walter, L. M., and Marzolf, S. S. The relation of sex, age, and school achievement to levels of aspiration. *J. educ. Psychol.*, 1951, 42, 285-292.

EMOTIONAL DEPENDENCE AND INDEPENDENCE IN A PHYSICAL THREAT SITUATION

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This paper reports an approach to measuring emotional dependence and independence in grade school children responding to a novel situation involving the threat of physical injury. One way in which people depend on others is by seeking reassurance in situations they perceive as threatening to themselves. We assume that a child develops the tendency to look to others for reassurance in threatening situations because others protect him from injury. Thus he learns to associate their presence, their encouraging remarks, or their help with being safe from harm. Thereafter, when he becomes anxious in anticipation of injury, the child may seek reassurance as a means of relieving his anxiety. In a study of children's fears of the dark and of high places, Holmes (2) demonstrated how children may utilize the reassuring presence of an adult as an emotional support in facing feared situations.

A child exhibits independence when physically threatened if he copes with the situation without requiring reassurance or help. It is assumed that he will tend to rely on himself if he expects that he can avoid injury or that he can tolerate whatever injury he may suffer. Also, the child may show independence as a way of winning approval from others, or as a way of avoiding their disapproval. Finally, he may express independence in order to experience the self-approval which comes from knowing that he has mastered a difficult or threatening situation.

METHOD AND SUBJECTS

In selecting a task for measuring dependence and independence under physical threat, six criteria were employed: (*a*) the task should involve the possibility of physical injury which all subjects will perceive; (*b*) it should not be so threatening that any grade school children will refuse to perform it; (*c*) it should be a task which children in the 6-12 age range are capable of performing independently; (*d*) it should be novel in order to minimize differences in the children's experience with similar tasks; (*e*) it should allow a clear choice between dependent and independent modes of coping with it; and (*f*) it should provide a series of trials to permit adjustive changes to be measured.

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The physical threat situation devised for this exploratory study was the Walk-the-Plank Test, a task which meets the six requirements relatively well. In this test, the subject was blindfolded and instructed to walk the length of a plank balanced on springs and raised eight inches off the floor. The plank was six feet long and 12 inches wide, with sideboards rising two inches above the level of the plank to prevent stepping off the side. It was pivoted at the center like a teeter-totter, and was attached at either end to a baseboard by two springs. It required a weight of about sixty pounds applied to the end of the plank to tip it downward until it touched the floor. To add to the instability of the plank, the cross-board on which it was pivoted was an inch higher at the center of the plank than at either side so that the plank tipped sidewise as well as endwise. One foot from the exit end of the plank, a small strip of wood was nailed across it so that the subject, when his foot bumped against the strip, would know he was near the end.

The subject was led into the testing room past the apparatus and seated at a desk facing away from the apparatus. When he went by the apparatus, he was not permitted to inspect it or test it in any way. After he was interviewed for about fifteen minutes in connection with another study, the subject was administered the Walk-the-Plank Test. For this, he was blindfolded with rubber goggles adapted for the purpose, then given the instructions which follow.

"This is a game where you walk along a wiggly board and step down to the floor when you get to the end. (E leads S to starting end of plank.) Step up. (E holds S's arm while S gets into position.) Turn this way. (E exerts pressure to turn S facing toward exit end of plank.) Feel the sides. (If necessary, E helps S bring his feet against both edge boards.) You will know when you get to the end because your toe will bump against a board stretched across the end. Walk between the sides till your toe bumps against the board, then step down to the floor."

"O.K. Do you want me to walk along with you this time?" (E touches back of S's hand and waits for him to accept or reject the help offered. If S takes the hand, E walks beside him to the end of the plank. If he ignores or rejects the hand, E walks silently behind him to catch him if he loses his balance.)

Five trials were given in immediate succession, with the subject led back to the starting end and helped into the starting position after each trial. At the beginning of each trial, the helping hand was offered in the same way and with the same statement as on the first trial. A record was kept of acceptance or rejection of the offer and of the subject's remarks. The reason for limiting the test to five trials was that previous exploratory work with the test indicated that a fair proportion of children become resistant if the number of trials exceeded five or so.

The subjects were 56 children, 31 boys and 25 girls, between six and 12 years of age. All were members of the Fels Research Institute's longitudinal research population which draws almost exclusively from the middle socio-economic class. The writer served as experimenter.

RESULTS

General Reactions to the Test

We may infer that a high proportion of the subjects perceived the task as physically threatening from the fact that two-thirds of them accepted the helping hand on the first trial while, of the remaining one-third, most were obviously tense and cautious while walking the plank. Subjects' spontaneous remarks, such as "It's scary," "I'm afraid I'll fall," and "It feels funny," verbalized the anxiety which they felt while performing the task. A small proportion of the subjects (about one in ten) behaved from the start with calm assurance, walking quickly and confidently along the plank and offering remarks such as "I like it" and "It's fun." Although nearly all of the subjects perceived the task as threatening, none of them refused to perform any of the five trials.

Concerning the novelty of the task, all 56 children reported, when interviewed at the end of the task ,that they had rarely been blindfolded before and never before had walked a springy board when blindfolded. Their experiences with blindfolds had been limited to occasional games of pin-the-tail-on-the-donkey, blind-man's buff, or the like.

The need for reassurance in coping with the situation was shown not only by taking the helping hand but, with several subjects, by leaning toward the experimenter while walking the plank. Some subjects rejected the hand but asked the experimenter to walk along beside them.

In interpreting the independence most subjects showed on the first or later trials, it is important to note that they were never instructed to walk the plank alone. The fact that most did so indicates their own tendencies toward independence, either because they assumed this was expected of them or because they desired to master the task. Typical remarks indicating their desire to perform the task alone were, "I'll try it by myself," "I believe I can," and "I'll do it alone."

Sex Differences

A popular notion is that girls are more fearful than boys in physical threat situations, and more inclined to be dependent on others for protection against injury. The present test offers the opportunity to check this notion in a situation which was highly novel for both the boys and girls who served as subjects.

For the sex comparison, twenty boys and twenty girls were selected from the 56 children on the basis of closest possible age matching. The means

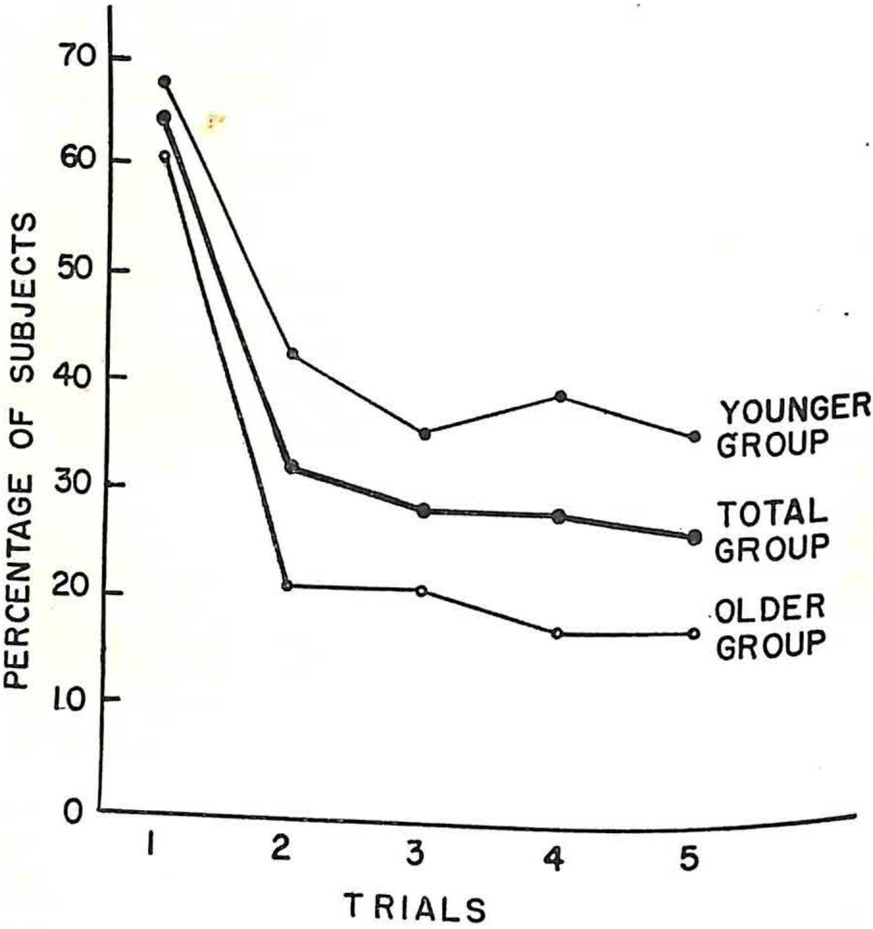

FIGURE 1—Percentages of subjects who accepted the helping hand on each of five trials in the Walk-the-Plank Test. The curves give results for 28 younger and 28 older children and for the total group of 56 children.

of both groups were 121.4 months. The median age of the boys' group was 129 months; of the girls' group, 130 months. Both groups had a semi-interquartile range of 17 months. On the first trial of the test, 12 of the boys and 14 of the girls accepted the helping hand. On all five trials taken together, the twenty boys accepted the helping hand a total of 32 times, the twenty girls also 32 times. The evidence of this study thus failed to support the view that girls are more fearful or less self-reliant than boys in physical threat situations when the factor of experience with the situation is controlled. If the boys did have more experience than the girls in facing physical threats, or if they were generally under more social pressure to exhibit courage, these differences did not generalize to this task.

Trial-to-Trial Differences

The Walk-the-Plank Test confronted the subjects with a situation which was novel in that it required them to walk an unstable platform without visual cues to direct them and to help them keep their balance. While almost all of the subjects were capable of doing the task without help, on Trial 1 they could not be sure of the hazards ahead or of their ability to cope with them. This meant that on Trial 1, anxiety and the associated need for reassurance should have been at a relatively high level, and a higher proportion of subjects would be expected to accept the helping hand on this trial than on later trials. After Trial 1, all the subjects had a more realistic basis for knowing the requirements of the task and for estimating their ability to perform it without aid. From this, it was reasonable to predict a greater decline in the number of subjects accepting the hand on Trial 2 (as compared with Trial 1) than would occur on Trials 3, 4 or 5 as compared to Trials 2, 3 or 4, respectively.

The results strongly supported this prediction. Thirty-six of the 56 subjects accepted the helping hand on Trial 1, 18 on Trial 2, 16 on Trial 3, 16 on Trial 4, and 15 on Trial 5. Figure 1 presents graphically the percentages of the 56 subjects who accepted the hand on each trial (note curve marked "Total Group"). The decline in the proportion of subjects who accepted the hand on Trial 2 as compared with Trial 1 was significant beyond the .01 level.[2] The further declines which occurred on Trials 3 and 5 were not significant.

Ten of the 56 children (six boys and four girls) accepted the hand on all five trials. Their failure to learn to walk without help raises significant questions for independence training in threatening situations. Five of the ten not only held the experimenter's hand but leaned on him as they walked the plank. This meant they were giving themselves no chance to learn to balance themselves and it is not surprising they remained dependent throughout the task. The conditions under which a person "throws away his crutches" in a threat situation is an important research problem.

The fact that nine subjects "regressed" by accepting the helping hand after walking without help on one or more trials indicates a conflict between dependent and independent tendencies. The most likely explanation is that, with these subjects, the experience of walking the plank by themselves increased their anxiety in anticipation of injury to the point where they resorted to help as a way of lessening their anxiety. The Walk-the-Plank Test evidently provides a good situation for further research on dependence-independence conflict directed to the question, "What situational variables determine the choice of dependent or independent responses in a physical threat situation?"

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[2] The proportion of subjects accepting the hand in Trial 1 was .643. Using the formula $\sigma_p = \sqrt{pq/N}$, the fiducial limits of $\pm 3\sigma_p$ for the population sampled in Trial 1 are .829 and .457. The proportion of subjects accepting the hand in Trial 2 was .321 which is outside these limits.

Age Differences

In this study it was assumed that dependent responses (taking the helping hand) indicated relatively high anxiety in anticipation of injury and/or relatively low tendencies to assert independence. By and large, older children were expected to have less anxiety than younger children in a given physical threat situation as a result of their greater capacities. Also, it was assumed that, in this culture, older children would have stronger needs to behave independently than younger children as a reflection of stronger social expectations that they handle situations on their own. These assumptions led to the prediction that older children would be less dependent(or more independent) than younger children in the Walk-the-Plank Test.

Considering that the test was a highly novel situation for the subjects and that none of them could know what to expect until after the first trial, it was predicted that on this trial the older children would express more nearly the same amount of dependence as younger children than would be true on later trials. In other words, it was assumed that the older subjects would be unable to utilize fully the advantages their greater capacities and experience gave them until they knew what the task required of them.

The age differences obtained support the analysis given above. The 56 children were divided into younger and older groups of 28 each. The younger group ranged from 80 to 114 months of age with a median age of 98 months, the older group from 114 to 150 months with a median age of 134 months. On trial 1, 19 of the younger and 17 of the older children accepted the helping hand. Thus, on the initial trial, age differences were at a minimum. On later trials, age differences were larger. On Trials 2, 3, 4 and 5, respectively, the numbers of younger children accepting the helping hand were 12, 10, 11 and 10. Corresponding numbers of older children were 6, 6, 5 and 5. These results are presented graphically in Figure 1. Another indication of age differences in the task was the fact that, of the ten children who accepted help on all five trials, eight were in the younger group.

While the age-differences found in this study were consistent with theoretical expectations, the data were insufficient to yield statistically significant differences.

Mothers' Behavior in Relation to Dependence-Independence

It is generally assumed that a child's parents play critical roles in determining his ways of dealing with problem situations. At the Fels Research Institute, data on the mothers' ways of relating to their children are available in the form of periodic ratings using the Fels Parent Behavior

Rating Scales. These thirty scales deal with various aspects of mothers' behavior toward their children. The ratings are made following a visit to the home by the Fels Home Visitor who observes the mothers' interaction with her children. These ratings offer the basis for an exploratory test of the relationships between certain aspects of mothers' behavior and the dependence-independence behavior of their children in the Walk-the-Plank Test.

Five of the 30 aspects of mothers' behavior rated in the Scales were selected on theoretical grounds as having particular relevance for learning to express dependent or independent tendencies in physical threat situations. These are Child-centeredness of Home, General Babying, Protectiveness, Accelerational Attempt, and Democracy of Policy. These scales have been described in detail by Baldwin, Kalhorn and Breese (1). They are characterized in briefest terms in this report.

High child-centeredness of the home means that the household revolves around the children, with major sacrifices made for the children's trivial comforts. Low child-centeredness means that the children's welfare is subordinated to that of other family members, with the children being left largely to fend for themselves. It was predicted that high child-centeredness would be associated with high dependence in the Walk-the-Plank Test on the assumption that it encourages the child to lean on others rather than taking care of himself in problem situations.

High babying means that the child is continually helped, even when he is fully capable of doing things by himself. Low babying means the child is left alone to solve his problems, and is often refused aid when he asks for it. It was predicted that high babying would be associated with high dependence in the Walk-the-Plank Test.

High protectiveness means that the child is sheltered from discomforts and difficulties, while low protectiveness means he is deliberately exposed to hazards or dangers. It was predicted that high protectiveness would be associated with high dependence on the Walk-the-Plank Test.

High acceleration means that the child is deliberately trained to develop skills, while low acceleration means he is held back from "growing up." It was predicted that high acceleration would be associated with high independence on the Walk-the-Plank Test on the assumption that acceleration involves training for mastery of situations.

High democracy of policy means that a child is given a definite share in deciding policies which concern him, while low democracy means that he is dictated to without regard to his own wishes. It was predicted that high democracy would be associated with high independence, assuming that it fosters self-reliance and discourages passive dependence.

To test the predictions, only the results for Trial 1 of the Walk-the-Plank Test were used. On later trials, too few subjects accepted the helping hand to permit adequate statistical analysis of differences between those subjects who accepted and those who rejected the helping hand. On Trial 1, thirty-six subjects accepted help and twenty rejected it. From the thirty-six who accepted help, twenty were selected strictly on the basis of choosing the group which most closely matched, in terms of sex and age, the group of twenty subjects who rejected help. Both groups contained 11 boys and nine girls. The Dependent Group (composed of subjects who accepted help) had a mean age of 119.9 months, the Independent Group (composed of subjects who rejected help) a mean age of 119.6 months. As further evidence that the groups were satisfactorily matched in terms of age, the Dependent Group had a median age of 124.5 months and a semi-interquartile range of 17.2 months, while the Independent Group had a median age of 127.0 months and a semi-interquartile range of 19.3 months.

In selecting ratings for use in this study, those made following the last home visit prior to the time the child was given the Walk-the-Plank Test were used. Since home visits are not conducted with children past the age of (approximately) ten years, the interval between the time the ratings were made and the time the data of this study were obtained was almost three years for some of the older subjects. The mean interval for the forty subjects involved in this part of the study was 18.3 months. With 63 per cent of the subjects, the interval was between 11 and 15 months; with eight per cent, between 16 and 24 months; and with 29 per cent, between 25 and 34 months. If one makes the plausible assumption that there is marked consistency from year to year in a mother's way of relating to her children, the time discrepancy should not render the home visit ratings selected inapplicable to the purpose of exploring relationships between mothers' behavior and the subjects' performance of the Walk-the-Plank Test.

The home visit ratings used were in the form of T-Scores, which place the individual in relation to other children in the Fels research population. A rating of 50 thus places the child at the mean of the norming group, a rating of 40 places him one sigma below the mean, while a rating of 60 places him one sigma above the mean. In comparing the parent-behavior ratings given children in the Dependent and Independent Groups, the mean T-Scores were computed for each group for each of the five mother-behavior variables. The reliabilities of differences in means of the Dependent and the Independent Groups were determined using Wilcoxon's non-parametric test for unpaired replicates (3).

Table 1 summarizes the results obtained with each of the five variables. It was predicted that high child-centeredness, high babying and high protectiveness would be associated with dependence rather than independence in the Walk-the-Plank Test. The results for child-centeredness and babying were in the predicted direction, though babying did not yield a significant difference. With protectiveness, a slight and insignificant difference was found in the opposite direction from that predicted. This finding may reflect unreliability of the measures employed, or it may indicate that the prediction made with respect to the protectiveness variable was incorrect.

It was predicted that high acceleration and high democracy would be associated with independence in the Walk-the-Plank Test. The results with both variables were in the predicted direction, though the difference in means was not significant with respect to democracy.

The results of this analysis support the view that a child's behavior in a physical threat situation is related to certain aspects of his mother's behavior toward him. Further research is needed to establish the nature and degrees of such relationships because of several limitations of this exploratory analysis. The results presented here involved too few subjects to be conclusive with some of the variables employed. The ratings of mothers' behavior used may be unrepresentative because they were based on a single home visit and because they were made from one to three years prior to the subjects' performance of the Walk-the-Plank Test. Also, no measure of the reliability of the Walk-the-Plank Test was available.

TABLE I

MEAN RATINGS ON FIVE MOTHER-BEHAVIOR VARIABLES FOR 20 SUBJECTS WHO ACCEPTED THE HELPING HAND (DEPENDENT GROUP) AND 20 SUBJECTS WHO REJECTED THE HELPING HAND (INDEPENDENT GROUP) ON TRIAL 1 OF THE WALK-THE-PLANK TEST

Mother-Behavior Variable	*Mean of Dependent Group*	*Mean of Independent Group*	*Difference*	*Predicted Direction?*	*Reliability*
Child-centeredness . . .	51.8	44.6	+7.2	Yes	<.02
Babying	47.6	44.0	+3.6	Yes	Non-signif.
Protectiveness	48.7	49.8	—1.1	No	Non-signif.
Acceleration	48.4	54.0	—5.6	Yes	<.05
Democracy	47.6	51.3	—3.4	Yes	Non-signif.

It should be noted that differences in mothers' behavior toward the children in the Dependent and the Independent Groups may reasonably be interpreted in two ways. It may be that a mother influences her child's performance in threat situations by indulging him or coaching him, or it may be that the child's behavior in problem situations influences the way his mother treats him. For example, a child may be fearful and dependent because his mother babies him, or his mother may baby him because he is fearful and dependent. Thus the data of this study do not permit determining whether the mother's behavior or the child's behavior was the independent variable.

DISCUSSION

The Walk-the-Plank Test is a promising technique for investigating dependent and independent responses to physical threat in grade school children. The task is threatening enough to arouse marked anxiety and to induce a high percentage of children to seek reassurance, particularly on the initial trial. At the same time it is not so threatening or so difficult that children as young as six years of age cannot perform it independently. The blindfold, in combination with the raised and unstable platform, offers a highly novel situation for children in the age range studied. Acceptance or rejection of the helping hand offers a clear differentiation of dependent and independent modes of coping with the task. The task as designed for this study is not well suited for studying individual adjustment to threats because, with most subjects, adjustment occurs within a trial or two. Also, the all-or-none measurement of dependent and independent responses does not permit ranking individuals in terms of fine differences in their adjustive responses to the situation. For these reasons, the task is primarily of value in differentiating groups of subjects in terms of dependent and independent behavior.

A major limitation of the task as employed in this study is that no measure was obtained of the amount of threat the subject perceived in the situation, or the amount of tension or anxiety it aroused. If measures of autonomic arousal or verbal reports of anxiety were obtained on each trial, dependent and independent modes of response could be interpreted more meaningfully. The task would probably be improved by blindfolding the subjects before they saw the apparatus. Also, it would probably be an improvement to reduce the instability of the plank since this would place less emphasis on differences in the subjects' skills in maintaining balance.

In considering further studies for which the Walk-the-Plank Test is suited, the investigation of factors which affect the shift from dependent to independent modes of coping with the situation seems particularly promising. Thus different techniques of offering reassurance might be employed with comparable groups of subjects. A comparison of the groups on, say, the fifth trial of the test would indicate the relative effects of the different techniques employed. Similarly, one group of subjects might be offered reassurance and help on each trial and another group required to perform the task on a "sink-or-swim" basis without any form of support. Also, the test lends itself to study of the effects of social factors such as the presence of one's parents or one's peers on performance of the task.

SUMMARY

1. This paper reports an exploratory study of emotional dependence and independence in the Walk-the-Plank Test which required the subject while blindfolded to walk the length of a six-foot plank balanced by springs

and raised eight inches off the floor. Fifty-six children, 31 boys and 25 girls, between six and 12 years of age individually performed five trials on the apparatus. On each trial, the subject might exhibit dependence by holding the experimenter's hand while he walked the plank, or he might exhibit independence by walking the plank without help.

2. Evidence was presented to indicate that almost all of the subjects perceived the task as threatening. However, the task was not so threatening that any of the subjects refused to perform any of the five trials.

3. No sex differences were found in the subjects' performance of the Walk-the-Plank Test.

4. Two-thirds of the subjects accepted the helping hand on the first trial of the test and approximately one-third on each of the succeeding four trials. The difference in the proportion of subjects accepting the helping hand on Trials 1 and 2 was significant. The fact that a very high proportion of the shifts from dependence to independence occurred on the second trial was interpreted as related to the novelty of the task on the first trial.

5. Almost the same proportion of younger and older children accepted the helping hand on the first trial of the test. However, on later trials, the younger children accepted the helping hand twice as often as the older children. The lack of evidence for age differences on Trial 1 was interpreted as related to the novelty of the task on that trial.

6. There was evidence that the amount of dependence or independence children showed in the Walk-the-Plank Test was related to certain aspects of their mothers' behavior toward them at home as rated with the Fels Parent Behavior Rating Scales.

7. The Walk-the-Plank Test was discussed in relation to its suitability for use with further studies of dependence and independence.

REFERENCES

1. BALDWIN, A. L., KALHORN, J. and BREESE, F. H. The appraisal of parent behavior. *Psychol. Monogr.*, 1949, 63, No. 4.
2. HOLMES, F. B. An experimental investigation of a method of overcoming children's fears. *Child Develpm.*, 1936, 7, 6-30.
3. WILCOXON, FRANK. *Some rapid approximate statistical procedures.* (Rev. July 1949.) American Cyanamid Co., 30 Rockefeller Plaza, New York City.

THE PROTEIN, CALCIUM, PHOSPHORUS, AND MAGNESIUM CONTENT OF NURSERY SCHOOL LUNCHES INCLUDING "SECONDS"

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A knowledge of the composition of nursery-school meals is of importance if the daily intake is to be adequate. Studies of this nature are few; estimated values rather than determined ones are given. Two studies made of the North Texas State College Nursery School meals have been published; the first (7) determined the vitamin A and ascorbic acid of the noon meal plus fluid milk and mid-morning fruit juice; the preformed vitamin A alone was in excess of the National Research Council's recommended daily allowance for this age group while the ascorbic acid provided one half of the day's requirement. The second study (3) determined the nitrogen, calcium and phosphorus content of similar meals. Nitrogen expressed as protein provided 14 to 22 per cent of the recommended allowance for this age group, 24 to 34 per cent of the calcium, and 21 to 27 per cent of the phosphorus. Each child was permitted as many "seconds" as he desired provided he had consumed all of the original food given him. Records were kept of the number and kind of "seconds" consumed by each child but the composition of these foods was not determined. The authors of these studies commented on the need for such analyses in order to obtain a true picture of the nutrients furnished by the nursery school lunches. Consequently, the present study was undertaken to determine the range of protein, calcium, phosphorus and magnesium provided the children when the "seconds" of the best and poorest eater in each age group were also analyzed.

PROCEDURE

Ten noon lunches (mid-morning fruit juice, composite food and fluid milk) and the daily "seconds" of a best and a poorest eater from both the younger and the older age group of children were analyzed for nitrogen during the summer of 1952 and for calcium, phosphorus, and magnesium during the summer of 1953. The technique of collecting and preserving a serving of food from each group as well as the sampling of the mid-morning fruit juice and fluid milk was previously reported (7). The

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"seconds" of the best and poorest eater from each age group were obtained in duplicate at the time the child was served. The values of the "seconds" when added to the value of the composite food and fluid milk gave the range of nutrients consumed by each age group.

The macro-Kjeldahl method was used in determining the nitrogen of the samples and converted to protein for comparison with the National Research Council's recommended daily allowance for these age groups. The calcium, phosphorus, and magnesium content of these same samples were determined gravimetrically (5, 8).

RESULTS

Since the original servings of the day's composite food and fluid milk had been found earlier (3) to be low in protein, an attempt was made to increase the protein content of the present lunches by substituting and by supplementing the recipes with a protein concentrate (MPF), Formula B.[2] During periods II and III the menus were identical but the MPF was used as a substitute for the cereal, meat, or cheese during period II, while it was used as an added supplement to these same recipes during period III. It is evident (Table 1) that the average protein intake for period III, 6.05 gm., is slightly larger than the 5.21 gm. for the same menus (period II) with the MPF substituted for part of the cereal, meat or cheese. It is also evident that the average for period I, during which there was no planned substitution or additive use of MPF, was almost as great, 5.97 gm., as that with the MPF added as a supplement, 6.05 gm. The amount and kind of protein foods served seem to determine the total protein of the composite food plus milk values rather than either the substitution or addition of the protein concentrate used.

This is also evident under the heading of the best eater of the younger group whose "seconds" increased his average daily intake of protein by 2.72, 1.82 and 2.52 gm. during the three periods of the study. The poorest eater in this group consumed a great many "seconds" of meat balls the first day of period I, which accounts for his only high "seconds" during the three periods.

The best eater had "seconds" of both composite foods and milk each day while the poorest eater had no "seconds" of either composite foods or milk on three days, and only composite "seconds" or milk "seconds" on four other days, leaving three days on which he had "seconds" of both composite foods and fluid milk. The protein intake of the poorest and best eaters of the younger group provided 8.10 and 12.30, 7.25 and 10.52, and

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[2] Multi-Purpose Food, Formula B, ingredients: soy grits, salt, fortified with calcium pyrophosphate, kelp, vitamin A ester, irradiated ergosterol, vitamin B_1, Riboflavin (B_2), and niacinamide. This was obtained from Meals for Millions, Foundation Incorporated, 648 South Broadway, Los Angeles 14, California.

8.86 and 11.90 gm. for periods I, II, and III, respectively. In other words, the best eaters received about one and one-half times as much protein from their noon lunches as did the poorest eaters.

For each period (Table 2) the older group of children were given slightly larger servings of each food which resulted in a slightly higher intake of protein from composite foods plus milk. The best and the poorest eaters from this age group consumed almost the same amount of protein daily during this study. In fact, during period II the poorest eater consumed more protein rich foods than did the best eater. The poorest eater of this group had "seconds" every day of composite food and of milk every day but one. The protein intake for the poorest and best eaters of the older group was 11.35 and 11.33, 9.65 and 8.25 and 11.44 and 10.80 gm. for periods I, II, and III respectively.

TABLE 1

TOTAL PROTEIN CONTENT OF THE LUNCHES EATEN BY THE BEST AND POOREST EATERS OF THE YOUNGER GROUP DURING EACH OF THE THREE PERIODS STUDIED

		GRAMS PROTEIN FROM COMPOSITE FOOD PLUS MILK AND "SECONDS"							
		Best Eater				Poorest Eater			
Periods	*Days*	*Composite Food Plus Milk*	*Seconds of Composite Food**	*Seconds of Milk*	*Total*	*Composite Food Plus Milk*	*Seconds of Composite Food**	*Seconds of Milk*	*Total*
I	1	7.02	4.61	2.34	13.97	7.02	4.17†	0.00	11.19
	2	4.77	2.15	2.91	9.83	4.77	0.00	0.00	4.77
	3	6.56	2.97	2.34	11.87	6.56	0.00	0.00	6.56
	4	5.54	4.71	3.27	13.52	5.54	0.00	4.36	9.90
	Ave.	5.97	3.61	2.72	12.30	5.97	1.04	1.09	8.10
II	1	5.75	4.46	2.18	12.39	5.75	1.62	2.18	9.55
	2	4.74	2.07	1.09	7.90	4.74	0.15	0.00	4.89
	3	5.15	3.95	2.18	11.28	5.15	0.00	2.18	7.33
	Ave.	5.21	3.49	1.82	10.52	5.21	0.59	1.45	7.25
III	1	6.12	3.94	2.52	12.58	6.12	1.74	2.52	10.38
	2	5.35	3.21	2.52	11.08	5.35	0.00	0.00	5.35
	3	6.67	2.84	2.52	12.03	6.67	1.65	2.52	10.84
	Ave.	6.05	3.33	2.52	11.90	6.05	1.13	1.68	8.86

* While "seconds" varied in size the portion analyzed in each case was identical for the specific "seconds" taken by the child.

† Milk "second" was put in with the food.

TABLE 2

TOTAL PROTEIN CONTENT OF THE LUNCHES EATEN BY THE BEST AND POOREST EATERS OF THE OLDER GROUP DURING EACH OF THE THREE PERIODS STUDIED

		GRAMS PROTEIN FROM COMPOSITE FOOD PLUS MILK AND "SECONDS"							
		Best Eater				Poorest Eater			
Periods	*Days*	*Composite Food Plus Milk*	*Seconds of Composite Food**	*Seconds of Milk*	*Total*	*Composite Food Plus Milk**	*Seconds of Composite Food**	*Seconds of Milk*	*Total*
I	1	7.15	3.86	4.68	15.69	7.15	6.94	2.34	16.43
	2	5.02	2.15	2.34	9.51	5.02	4.51	2.34	11.87
	3	6.16	0.00	2.34	8.50	6.16	.40	2.34	8.90
	4	5.71	1.54	4.36	11.61	5.71	1.40	1.09	8.20
	Ave.	6.01	1.89	3.43	11.33	6.01	3.31	2.03	11.35
II	1	5.82	2.19	2.18	10.19	5.82	6.76	1.09	13.67
	2	5.46	1.67	2.18	9.31	5.46	1.57	0.00	7.03
	3	5.25	0.00	0.00	5.25	5.25	0.81	2.18	8.24
	Ave.	5.51	1.29	1.45	8.25	5.51	3.05	1.09	9.65
III	1	7.00	2.23	2.52	11.75	7.00	2.96	2.52	12.48
	2	6.00	1.54	2.52	10.06	6.00	0.51	2.52	9.03
	3	6.19	1.88	2.52	10.59	6.19	1.08	2.52	9.79
	Ave.	6.40	1.88	2.52	10.80	6.40	1.52	2.52	10.44

* While "seconds" varied in size the portion analyzed in each case was identical for the specific "seconds" taken by the child.

The calcium, phosphorus and magnesium (Table 3) content of composite food plus milk, "seconds" and totals for the best and poorest eater of the younger group are given. The initial composite food plus milk values 442, 263, and 91 mg. of calcium, phosphorus and of magnesium were increased by "seconds" of 60, 31, and 13, to 502, 294, and 104 mg. for the best eater, while the poorest eater only increased his by 11, 4, and 5 mg. to 453, 267 and 97 mg. per meal.

Similar data are given for the best and poorest eater of the older age group (Table 4). The original servings of composite food and milk furnished the older group more calcium, and magnesium but with slightly less of phosphorus, than that of the younger group. The slight difference of the latter could be due to the difference in composition of a serving of one of the composite foods, especially since many of their composite foods were dishes made of several combinations, as macaroni and cheese, meat loaf, cheese sauce on rice, spaghetti and meat balls, and the like. In all instances, the poorest eater in the older group consumed fewer "seconds" than did the best eater; with the result that his "seconds" contributed only 10, 3, and 2 mg. as compared with 91, 90, and 21 mg. of calcium, phosphorus and magnesium contributed by the "seconds" of the best eater. Consequently, the average total daily intake of calcium, phosphorus and magnesium 550, 349, and 122 mg., of the best eater is greater than that of the poorest eater who consumed 470, 262, and 102 mg. of these elements.

TABLE 3

CALCIUM, PHOSPHORUS AND MAGNESIUM CONTENT OF COMPOSITE FOOD PLUS FLUID MILK AND "SECONDS" CONSUMED BY THE YOUNGER GROUP

	Calcium			Phosphorus			Magnesium		
Day	*Composite Plus Milk* mg	*Seconds* mg	*Total* mg	*Composite Plus Milk* mg	*Seconds* mg	*Total* mg	*Composite Plus Milk* mg	*Seconds* mg	*Total* mg
"Best":									
1 . . .	541	93	643	265	67	332	111	67	178
2 . . .	460	79	539	307	43	350	107	16	123
3 . . .	395	180	575	202	84	286	65	9	74
4 . . .	381	88	469	184	78	262	66	12	78
5 . . .	565	. .	565	435	. .	435	117	. .	117
6 . . .	490	32*	522	243	8	251	80	5*	85
7 . . .	403	32*	435	288	8	296	79	5*	84
8 . . .	315	32*	237	158	8	166	83	5*	88
9 . . .	428	32*	460	271	8	279	114	5*	119
10 . . .	441	32*	473	275	8	283	92	5*	97
Ave. .	442	60	502	263	31	294	91	13	104
"Poorest":									
1 . . .	541	108	649	265	40	305	111	54	165
2 . . .	460	. .	460	307	. .	307	107	. .	107
3 . . .	395	. .	395	202	. .	202	65	. .	65
4 . . .	391	. .	381	184	. .	184	66	. .	66
5 . . .	565	. .	565	435	. .	435	117	. .	117
6 . . .	490	. .	490	243	. .	243	80	. .	80
7 . . .	403	. .	403	288	. .	288	79	. .	79
8 . . .	315	. .	315	158	. .	158	83	. .	83
9 . . .	428	. .	428	271	. .	271	114	. .	114
10 . . .	441	. .	441	275	. .	275	92	. .	92
Ave. .	442	11	453	263	4	267	91	5	97

* Since these "seconds" were so small, a composite sample was made.

TABLE 4

CALCIUM, PHOSPHORUS AND MAGNESIUM CONTENT OF COMPOSITE FOOD PLUS FLUID MILK AND "SECONDS" CONSUMED BY THE OLDER GROUP

	Calcium			Phosphorus			Magnesium		
Day	*Total Lunch and Milk* mg	*Food Seconds* mg	*Total* mg	*Total Lunch and Milk* mg	*Food Seconds* mg	*Total* mg	*Total Lunch and Milk* mg	*Food Seconds* mg	*Total* mg
"Best":									
1 . . .	532	184	716	252	48	300	81	24	105
2 . . .	489	53	542	274	64	338	155	23	178
3 . . .	402	172	574	205	120	325	66	15	81
4 . . .	405	83	488	228	86	314	67	21	88
5 . . .	627	. .	627	374	. .	374	132	. .	132
6 . . .	446	83	529	264	116	380	84	26	110
7 . . .	443	83	526	273	116	389	112	26	138
8 . . .	314	83	397	163	116	279	100	26	126
9 . . .	490	83	573	299	116	415	121	26	147
10 . . .	446	83	529	263	116	379	91	26	117
Ave. .	459	91	550	260	90	349	101	21	122
"Poorest":									
1 . . .	532	103	635	252	25	277	81	16	97
2 . . .	489	. .	489	274	. .	274	155	. .	155
3 . . .	402	. .	402	205	. .	205	66	. .	66
4 . . .	402	. .	402	228	. .	288	67	. .	67
5 . . .	627	. .	627	374	. .	374	132	. .	132
6 . . .	446	. .	446	264	. .	264	84	. .	84
7 . . .	443	. .	443	273	. .	273	112	. .	112
8 . . .	314	. .	314	163	. .	163	100	. .	100
9 . . .	490	. .	490	299	. .	299	121	. .	121
10 . . .	446	. .	446	263	. .	263	91	. .	91
Ave. .	459	10	470	260	3	262	101	2	102

The National Research Council recommends a daily allowance of protein for these age groups of 40 and 50 gm. for the younger and older groups, respectively. The nursery school lunches analyzed, including "seconds," provided about one fifth of the recommended amount for the poorest eater of the younger group, while the best eater of the younger group received one third of this daily allowance. A recent study (1) revealed that 50 per cent of the children of the study had a daily protein intake below that recommended by the National Research Council. The lowest total intakes averaged 25 gm. of protein per day for children between the ages of 32 and 59 months which includes the age range of the children in the present study. The protein intake of the present study seems low when compared with the National Research Council's recommended daily allowance but it is in line with this recent study (1) furnishing one third to one half of the amount consumed by 50 per cent of these chidren.

The National Research Council recommends a daily allowance of 1 gram of calcium, assuming that if the calcium need is met that the one for phosphorus will also be met. All of the children of the present study received about one half of this amount of calcium. The poorest eater of both the younger and the older groups lacked less than .05 gm. of consuming this amount while the best eaters of each group consumed slightly more than half of a gram of calcium. The phosphorus values of these nursery school lunches do not provide enough phosphorus although the calcium is adequate. Sherman and Hawley (6) state that one quart of milk or one gram each of calcium and of phosphorus are deemed necessary per child per day. Only the best eater of the older group received more than a third of a gram of phosphorus. It is believed that this lower phosphorus is associated with the lower total protein intake since the calcium provided was adequate.

The magnesium requirements have been studied to a lesser degree than those of calcium and of phosphorus. This may in part be accounted for by the many interfering substances present in food which make the chemical analysis of magnesium difficult (4). The most extensive study, Daniels (2), calculated the magnesium intake of three preschool age boys on basis of their body weight and found that they ranged from 198 to 273 mg. per day. Using this as the standard for the present study, since the age ranges are the same, all of the children in the present study received 50 per cent or more of this amount of magnesium in their noon meal.

One may summarize these findings with the statement that the lunches provided an adequate amount of both calcium and magnesium but an inadequate amount of protein and of phosphorus. To improve the intake of the latter two, the protein rich foods, other than fluid milk, should be increased.

SUMMARY

The nursery school lunches analyzed, including "seconds," for a best and a poorest eater in each age group provided an average of 11.57 and 8.07 gm. protein for the younger group and 10.13 and 10.48 gm. for the older group.

The foods supplied to all of the children about one half of a gram of calcium but only one third of a gram of phosphorus.

The magnesium supplied ranged from 98 to 122 mg. It is assumed that this amount represents about one half of a daily requirement of this age group.

REFERENCES

1. BEAL, VIRGINIA A. Nutritional intake of children. *J. Nutri.*, 1953, 50, 223.
2. DANIELS, A. L. Magnesium needs of pre-school children. *Am. J. Dis. Child.*, 1941, 62, 568-576.
3. DAVIS, NELL and SCOULAR, F. I. Calcium, phosphorus and nitrogen of nursery school lunches. *Child Develpm.*, 1952, 23, 83-90.
4. MACY, I. G. *Nutrition and chemical growth in childhood, II.* Springfield, Ill.: C. C. Thomas, 1942.
5. SCOTT, W. W. *Standard methods of chemical analysis.* New York: Van Nostrand, 1939.
6. SHERMAN, H. C. ,and HAWLEY, E. Calcium and phosphorus metabolism in childhood. *J. Biol., Chem.*, 1922, 53, 375-399.
7. TOMPKINS, V. L., and SCOULAR, F. I. Vitamin A, carotene and ascorbic acid of nursery school lunches. *Am. J. Dis. Child.*, 1948, 76, 184-191.
8. Association of Official Agricultural Chemists, *Methods of Analysis.* 7th Ed., 1950.
9. Multi-Purpose Food, Formula B, obtained from Meals for Millions Foundation Incorporated, 648 So. Broadway, Los Angeles 14, Calif.

THE EFFECT OF NUTRITIVE FAILURE ON THE GROWTH PATTERNS OF WHITE CHILDREN IN ALABAMA[1]

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and TOM D. SPIES

Optimal conditions throughout the growing period allow a child to reach the maximum physical development compatible with his heredity. In each child, physical growth must be completed within the limits set by time. Thus the attainment of maximum physical development depends upon a child's ability to remove any accumulated growth debt before the epiphyses and diaphyses of the major long bones undergo fusion.

Chronic nutritive failure as a predisposing cause of growth lag in children has been under study at the Nutrition Clinic of the Hillman Hospital, Birmingham, Alabama, since 1941 (1, 3, 4, 6, 7). During the past decade the growth patterns of more than three thousand children with and without nutritive failure have been investigated. In evaluating growth progress in terms of increases in height and body weight, use was made of the Wetzel Grid and of the height and weight standards developed by Simmons from normal Cleveland children (5, 8). It was postulated that any error inherent in comparing the heights and weights of homogeneous groups of Alabama children to standards derived from a homogeneous group of Ohio children would be relatively constant. While this procedure was adequate for the determination of the relative effects of chronic nutritive failure on the height and weight progress of growing children, it did not provide the absolute values essential for a complete analysis. Accordingly, an investigation was devised whereby the growth patterns of children with chronic nutritive failure have been compared to a standard of reference developed from data obtained in the same geographic area from an ethnically identical group of children without nutritive failure.

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Table I

MEAN HEIGHTS OF TEST AND CONTROL CHILDREN

	BOYS							GIRLS						
	Test			Control				Test			Control			
Age (Yrs.-Mos.)	*No. of Cases*	*Mean Height* (Inches)	*S.D.**	*No. of Cases*	*Mean Height* (Inches)	*S.D.**	*Diff. in Means*	*No. of Cases*	*Mean Height* (Inches)	*S.D.**	*No. of Cases*	*Mean Height* (Inches)	*S.D.**	*Diff. in Means*
3—0	26	35.73	1.67	5	38.93	1.84	3.20	15	35.49	2.29	7	36.53	1.79	1.04
3—3	28	36.51	1.66	10	39.56	2.89	3.05	26	36.44	2.20	9	38.26	2.41	1.82
3—6	28	37.33	2.06	9	39.29	2.56	1.96	29	37.22	1.98	10	38.26	1.88	1.04
3—9	34	37.62	2.10	20	40.55	2.45	2.93	31	36.66	3.47	10	39.27	1.56	2.61
4—0	42	38.59	2.25	18	40.63	2.75	2.04	43	37.47	3.35	23	40.20	1.93	2.73
4—3	32	39.05	2.11	19	41.85	1.95	2.80	43	39.38	3.14	20	40.82	2.01	1.44
4—6	37	39.89	1.43	13	42.52	1.85	2.63	35	39.69	2.48	22	41.63	2.93	1.94
4—9	41	40.74	1.93	17	43.81	3.31	3.07	45	40.98	2.45	20	42.81	2.62	1.83
5—0	35	41.57	1.88	14	43.00	4.24	1.43	35	41.20	2.60	20	42.43	2.54	1.23
5—3	43	41.69	2.38	17	45.00	2.56	3.31	63	42.01	4.08	16	43.62	3.35	1.61
5—6	44	42.41	2.27	19	46.20	3.67	3.79	56	42.02	2.49	14	44.50	3.61	2.48
5—9	52	43.35	2.45	25	45.23	2.79	1.88	53	43.02	2.88	15	45.11	2.66	2.09
6—0	56	43.71	2.50	29	45.32	3.09	1.16	59	44.11	3.96	29	45.71	2.60	1.60
6—3	52	44.14	2.72	43	46.95	2.44	2.81	67	44.52	2.91	36	45.99	3.54	1.47
6—6	47	43.94	2.93	28	46.74	2.68	2.80	65	44.58	2.61	33	46.70	3.20	2.12
6—9	58	45.49	2.84	46	47.87	3.66	2.38	63	45.45	2.74	28	46.82	2.66	1.37
7—0	66	45.67	3.09	32	48.44	2.80	2.77	60	46.29	3.25	28	46.97	3.88	0.68
7—3	78	47.52	3.11	33	49.15	3.16	1.63	78	47.21	3.35	27	47.28	3.24	0.07
7—6	77	47.46	2.60	30	49.12	3.26	1.66	73	47.56	3.13	34	48.98	4.00	1.42
7—9	80	48.02	2.48	32	49.60	4.07	1.58	79	47.78	3.35	25	48.72	4.06	0.94
8—0	83	48.65	2.59	39	50.65	3.13	2.00	88	48.44	2.91	50	50.05	3.88	1.61
8—3	74	49.15	2.70	41	51.16	3.65	2.01	93	49.09	2.72	34	50.80	3.08	1.71

8—6	74	49.62	2.84	38	51.57	3.99	1.95	82	49.45	2.87	32	50.79	3.20	1.34
8—9	70	50.17	2.70	28	52.64	4.39	2.47	79	50.04	3.34	28	51.90	3.10	1.86
9—0	89	50.94	3.18	31	52.46	3.91	1.52	91	50.51	3.56	23	52.31	3.98	1.80
9—3	72	51.00	2.58	21	53.66	2.89	2.66	98	51.21	3.16	27	52.46	3.68	1.25
9—6	89	51.79	3.08	28	53.10	3.70	1.31	71	51.87	4.29	31	53.43	3.48	1.56
9—9	76	52.37	3.58	26	54.22	4.19	1.85	98	52.17	4.25	20	53.26	3.95	1.09
10—0	81	52.40	3.55	31	54.25	3.62	1.85	93	52.65	3.55	29	54.55	3.94	1.90
10—3	66	53.21	3.55	21	55.20	1.00	1.99	102	53.22	4.29	39	54.95	4.35	1.73
10—6	70	53.50	3.64	29	55.39	4.02	1.89	93	53.01	3.62	28	55.36	3.54	2.35
10—9	78	53.83	2.69	26	56.05	3.86	2.22	91	54.16	3.44	22	55.51	4.27	1.35
11—0	85	54.84	3.46	24	56.71	6.16	1.87	97	54.93	3.56	26	57.08	4.28	2.15
11—3	62	54.89	3.72	27	56.90	4.07	2.01	85	54.94	3.60	33	57.56	4.72	2.62
11—6	66	55.83	4.41	24	57.32	4.11	1.49	84	55.94	3.28	33	58.04	4.50	2.10
11—9	68	55.79	3.51	22	57.55	3.82	1.76	70	56.81	3.87	29	59.47	3.86	2.66
12—0	55	56.60	4.27	24	57.71	4.41	1.11	80	57.12	3.62	43	59.90	2.79	2.78
12—3	64	56.64	3.56	24	59.16	4.09	2.52	72	57.80	4.33	30	60.54	4.18	2.74
12—6	52	57.10	4.09	28	59.49	4.66	2.39	64	58.15	4.97	46	60.41	4.31	2.26
12—9	56	57.86	4.44	18	60.36	4.61	2.50	56	59.27	4.51	32	60.02	4.88	0.75
13—0	49	58.84	4.13	11	60.45	4.05	1.61	58	59.30	4.14	27	61.28	3.91	1.98
13—3	37	59.12	5.15	28	62.66	8.16	3.54	42	59.24	3.73	29	62.63	3.21	3.39
13—6	46	59.89	4.26	22	62.39	4.17	2.50	47	60.75	4.32	27	62.56	3.53	1.81
13—9	32	59.57	4.50	23	62.73	6.66	3.16	53	60.73	3.08	29	62.31	3.56	1.58
14—0	38	59.41	3.90	27	65.02	8.35	5.61	38	60.98	3.42	37	62.92	3.36	1.94
14—3	43	60.66	4.51	32	65.43	3.83	4.77	41	61.38	3.70	46	63.34	3.42	1.96
14—6	37	61.20	4.51	33	66.04	4.94	4.84	29	59.83	4.50	38	62.76	3.04	2.93
14—9	24	61.94	4.67	38	65.54	4.52	3.60	43	61.89	2.64	45	63.38	3.19	1.49
15—0	26	62.89	5.41	47	66.97	4.64	4.08	29	61.08	3.24	33	64.26	2.91	3.18
15—3	15	62.38	4.54	45	66.16	5.04	3.78	26	62.69	2.74	35	62.90	3.78	0.21
15—6	20	64.47	3.67	43	67.33	4.32	2.86	24	62.34	3.99	39	63.55	3.74	1.21
15—9	15	64.13	3.43	43	66.81	4.56	2.68	17	61.81	3.55	34	63.36	2.86	1.55

• *S.D.* = Standard Deviation.

MATERIALS AND METHODS

A total of 2404 children without evidence of nutritive failure served as the reference group (control group). Of these, 1182 were boys and 1222 were girls. The group with chronic nutritive failure (test group) consisted of 561 children of which 267 were boys and 294 were girls. Each child was white, of Anglo-Saxon extraction and a resident of the Birmingham district. The groups ranged in age from 2 years 11 months to 15 years 11 months. Height and weight measurements of each child were made by staff members of the Nutrition Clinic by the method described in a previous publication (2).

In compiling the height and weight curves for each sex in each group, mean values were calculated for each 3-month interval between 3 years 0 months and 15 years 9 months. To derive these means, the readings for each child whose chronological age fell within plus/minus one month of a quarter, half, three-quarters and a full year were combined. The reference curves and the curves for the group with nutritive failure were developed from 2853 and 5921 measurements respectively. Of these, 1401 were for boys in the reference group, 1452 for girls in the reference group, 2769 for boys with nutritive failure and 3152 for girls with nutritive failure. The distribution of readings for each sex in each group at each 3-month interval is shown in Tables 1 and 2. The standard deviation indicative of the average deviation from the mean, and the coefficient of variation which relates the measure of dispersion to the mean were calculated for height and weight at each 3-month interval.

The mean speed of growth of each group was determined by converting the height and weight values for each sex at each 3-month interval into isodevelopmental levels by the techniques developed by Wetzel (9). The mean isodevelopmental levels and their standard deviations were plotted on a Wetzel Grid. The resulting curves permitted a comparison of: (*a*) the mean speed of growth of the reference group as contrasted with that of the Wetzel "normal," and (*b*) the mean speed of growth of the group with nutritive failure as contrasted with that of the reference group.

Comparison of the Mean Height Progress of White Alabama Children With and Without Nutritive Failure

The mean height values and standard deviations are presented in Table 1. The coefficients of variation ranged from 3.9 per cent to 13.0 per cent with a mean of 7.0 per cent for the children in the control group and from 3.6 per cent to 9.7 per cent with a mean of 6.4 per cent for the children with nutritive failure. The relatively low coefficients of variation are indicative of a narrow dispersion of individual values about the means in each group at each age.

The mean heights of the control children exceeded those of the undernourished group at each 3-month interval except at 7 years 3 months when the values for the two groups of girls were identical. The average height difference throughout the age range under investigation was 2.42 inches for the boys and 1.77 inches for the girls. The range for the boys extended from a mean of 1.11 inches at 12 years to 5.61 inches at 14 years; for the girls from a mean of 0 inches at 7 years 3 months to 3.60 inches at 13 years 3 months. The maximum mean height reached by the boys with nutritive failure was 64.5 inches at 15 years 6 months, a value attained by the boys in the control group at 14 years 0 months. The girls with nutritive failure achieved their maximum mean height of 62.7 inches at 15 years 3 months; the control girls reached this value at 14 years 0 months.

The mean height curves of the control boys and the undernourished boys showed a close parallelism between 3 years and 13 years of age, followed by a divergence which reached a peak at 14 years of age. The corresponding curves for the girls were parallel between 3 years and 6 years of age. From 6 years of age to 7 years 3 months, the curves converged, culminating in identical values at the latter age. The curves underwent a progressive divergence from 7 years 3 months to 15 years and converged thereafter. With the exception of ages 3 years to 5 years 6 months in the boys, the mean height curves of the control children fell within plus one standard deviation of the mean height values of the undernourished children. Conversely, and with a similar exception, the mean height curves of the undernourished children fell within minus one standard deviation of the mean height values of the control children.

Comparison of the Mean Weight Progress of White Alabama Children With and Without Nutritive Failure

The mean weight values and standard deviations are shown in Table 2. The coefficients of variation ranged from 4.6 per cent to 25.5 per cent with a mean of 14.4 per cent for the control children and from 5.1 per cent to 19.5 per cent with a mean of 11.4 per cent for the children with nutritive failure. These values are indicative of a substantially greater dispersion of individual weight values about the means than was noted for the height readings.

The mean weight values of the control children exceeded those of the children with nutritive failure at each 3-month age interval. The mean weight differentials for the boys ranged from 2.43 pounds at 3 years 6 months to 33.9 pounds at 15 years 3 months; those for the girls ranged from 0.49 pounds at 3 years to 23.7 pounds at 13 years 3 months. The mean weight differentials at each age interval were 12.74 pounds for the boys and 11.34 pounds for the girls. The boys with nutritive failure attained their maximum mean weight of 111 pounds at 15 years 9 months of age. The control boys reached this value at 13 years 6 months. The maximum mean weight achieved by the girls with nutritive failure was

TABLE 2

MEAN WEIGHTS OF TEST AND CONTROL CHILDREN

	BOYS							GIRLS						
	TEST			CONTROL				TEST			CONTROL			
Age (Yrs.-Mos.)	No. of Cases	Mean Weight (Pounds)	S.D.*	No. of Cases	Mean Weight (Pounds)	S.D.*	Diff. in Means	No. of Cases	Mean Weight (Pounds)	S.D.*	No. of Cases	Mean Weight (Pounds)	S.D.*	Diff. in Means
3—0	26	31.01	1.86	5	35.30	1.61	4.29	15	28.62	1.80	7	29.11	1.73	0.49
3—3	28	32.41	2.58	10	35.08	4.76	2.67	26	31.06	2.75	9	33.41	3.49	2.35
3—6	28	32.82	3.07	9	35.25	2.26	2.43	29	31.03	2.98	10	33.57	2.61	2.54
3—9	34	33.65	3.08	20	39.38	4.03	5.73	31	32.21	2.96	10	35.70	4.26	3.49
4—0	42	34.63	3.99	18	39.30	3.90	4.67	43	33.12	2.93	23	36.18	2.90	3.06
4—3	32	35.48	3.01	19	42.34	4.06	6.86	43	34.24	4.25	20	37.62	3.96	3.38
4—6	37	36.58	3.19	13	42.50	5.40	5.92	35	34.12	5.93	22	39.29	4.47	5.17
4—9	41	37.95	3.17	17	43.63	5.85	5.68	45	36.08	3.62	20	40.97	4.37	4.89
5—0	35	39.00	6.07	14	44.92	4.48	5.92	35	36.25	3.32	20	40.57	5.31	4.32
5—3	43	38.44	3.48	17	46.73	5.27	8.29	63	37.85	3.58	16	41.99	3.80	4.14
5—6	44	40.78	3.54	19	46.78	4.07	6.00	56	37.76	3.52	14	44.00	6.94	6.24
5—9	52	41.68	3.94	25	46.90	6.84	5.22	53	39.30	4.49	15	45.69	5.04	6.39
6—0	56	42.08	3.75	29	46.66	4.74	4.58	59	40.75	4.45	29	48.68	6.64	7.93
6—3	52	43.12	4.36	43	50.30	4.37	7.18	67	42.11	4.36	36	46.95	6.31	4.84
6—6	47	44.37	4.26	28	49.49	7.05	5.12	65	41.59	4.14	33	49.28	6.61	7.69
6—9	58	45.45	4.87	46	51.83	7.31	6.38	63	43.71	4.79	28	48.53	4.24	4.82
7—0	66	47.86	4.33	32	55.61	5.65	7.75	60	45.19	6.26	28	50.88	5.95	5.69
7—3	78	48.77	5.17	33	54.99	6.21	6.22	78	46.78	5.99	27	51.24	7.63	4.46
7—6	77	49.23	4.95	30	56.39	10.06	7.16	73	48.20	5.12	34	54.84	9.85	6.64
7—9	80	51.61	4.52	32	58.95	9.31	7.34	79	48.60	6.17	25	54.52	8.30	5.92
8—0	83	52.29	4.55	39	60.78	6.40	8.49	88	49.83	5.27	50	58.38	9.39	8.55
8—3	74	53.52	5.91	41	61.53	8.39	8.01	93	51.89	6.94	34	61.21	11.55	9.32

8—6	74	54.41	5.62	38	62.42	10.10	8.01	82	52.03	6.48	32	62.23	11.48	10.20
8—9	70	56.42	4.80	28	65.98	12.12	9.56	79	53.87	6.83	28	65.92	10.81	12.05
9—0	89	57.54	5.94	31	66.05	9.94	8.51	91	54.49	7.33	23	68.97	13.36	14.48
9—3	72	57.40	6.18	21	70.56	10.69	13.16	98	56.83	8.29	27	64.78	8.79	7.95
9—6	89	60.25	8.22	28	70.18	12.92	9.93	71	57.58	7.16	31	68.35	11.94	10.77
9—9	76	61.88	7.90	26	72.38	12.48	10.50	98	59.49	7.22	20	69.10	9.44	9.61
10—0	81	62.36	7.65	31	72.92	10.19	10.56	93	60.47	7.80	29	77.41	12.64	16.94
10—3	66	64.08	7.44	21	74.81	7.84	10.73	102	62.17	8.84	39	77.23	14.66	15.06
10—6	70	64.94	8.62	29	75.11	12.71	10.17	93	63.33	8.97	28	80.39	17.64	17.06
10—9	78	66.67	9.72	26	77.82	12.51	11.15	91	65.91	8.62	22	78.84	13.93	12.93
11—0	85	69.30	7.96	24	82.16	12.10	12.86	97	67.53	8.17	26	83.69	14.01	16.16
11—3	62	69.38	8.06	27	82.86	12.39	13.48	85	67.45	8.36	33	87.82	16.17	20.37
11—6	66	72.89	9.02	24	81.67	13.49	8.78	84	70.94	9.29	33	89.42	15.78	18.48
11—9	68	72.16	9.29	22	84.96	12.79	12.80	70	74.51	10.79	29	91.98	14.88	17.47
12—0	55	74.39	9.54	24	87.07	17.75	12.68	80	74.98	9.44	43	94.09	18.45	19.11
12—3	64	75.78	8.96	24	90.00	16.57	14.22	72	77.42	11.60	30	98.72	14.72	21.30
12—6	52	79.67	9.72	28	95.23	17.45	15.56	64	79.18	15.47	46	100.67	16.90	21.49
12—9	56	79.43	12.61	18	100.62	18.12	21.10	56	84.77	13.57	32	100.96	15.07	16.19
13—0	49	85.74	11.35	11	102.08	15.82	16.34	58	85.25	13.66	27	104.45	18.99	19.20
13—3	37	83.66	13.20	28	113.10	26.00	29.44	42	82.80	15.30	29	106.50	15.32	23.70
13—6	46	85.90	12.40	22	110.72	21.84	24.83	47	91.19	16.10	27	107.18	15.80	15.99
13—9	32	85.16	12.25	23	105.56	13.44	20.40	53	94.43	18.47	29	107.75	16.29	13.32
14—0	38	86.03	11.10	27	119.41	22.97	33.38	38	90.46	13.14	37	108.02	13.24	17.56
14—3	43	90.34	14.44	32	123.77	19.71	33.43	41	94.26	17.38	46	115.69	19.61	21.43
14—6	37	95.98	16.66	33	129.21	22.98	33.23	29	96.97	12.40	38	114.33	17.64	17.36
14—9	24	96.24	17.58	38	121.18	18.20	24.94	43	97.87	13.63	45	109.27	11.32	11.40
15—0	26	102.85	16.32	47	127.65	16.09	24.80	29	99.40	12.82	33	118.45	15.76	19.05
15—3	15	98.67	17.37	45	132.57	21.64	33.90	26	100.90	14.93	35	112.96	17.73	12.06
15—6	20	110.47	12.44	43	133.07	16.17	22.60	24	100.53	15.55	39	117.06	16.27	16.53
15—9	15	110.99	20.40	43	131.61	19.19	20.62	17	99.70	14.89	34	113.20	14.18	13.50

• *S.D.* = Standard Deviation.

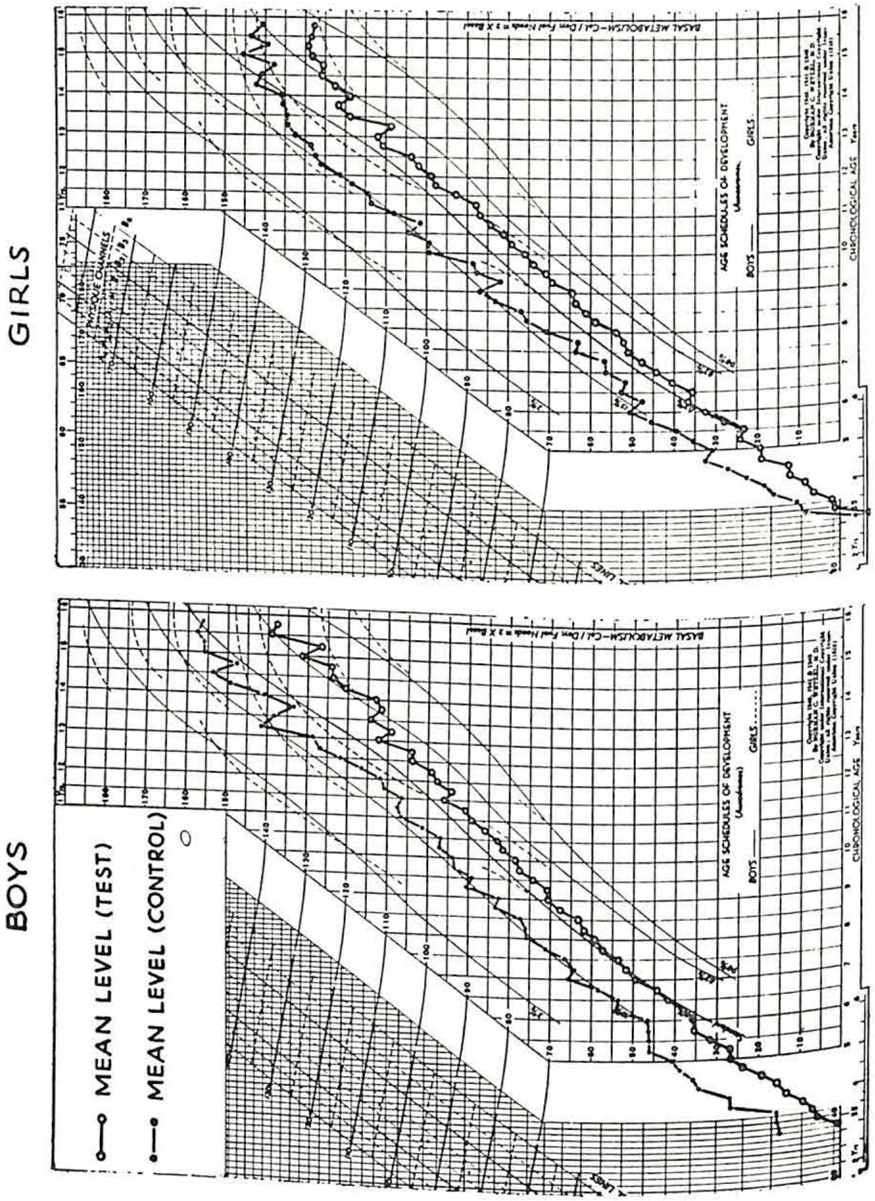

FIGURE 1—Comparison of mean isodevelopmental levels of test children with those of control children.

100.9 pounds at 15 years 6 months of age, a value reached by the control girls at 12 years 9 months.

The mean weight curves of the children in each group showed, in general, a progressive divergence throughout the age range included in this investigation. The mean weight curve of the control boys was more than plus one standard deviation removed from the mean weight values of the boys with nutritive failure at every age interval except 5 years 0 months. The mean weight curve for the control girls was more than plus one standard deviation greater than the mean weight values of the girls with the nutritive failure in the middle age range and either slightly above or below plus one standard deviation at the lower and higher ages. Conversely, the mean weight curve of the undernourished boys was more than minus one standard deviation removed from the means of the control boys in the upper age range and just above or below minus one standard deviation in the lower age range. In general, the mean weight curve of the girls with nutritive failure followed the course of the minus one standard deviation line calculated from the mean weight curve for the control girls.

Comparison of the Mean Speed of Growth of White Alabama Children With and Without Nutritive Failure

The mean isodevelopmental lines (Wetzel) reached by each group of children at each 3-month age interval are shown in Figure 1. The mean levels attained by the control children greatly exceeded those of the children with nutritive failure at each age. The mean differentials for the boys ranged from 8.70 levels at 3 years 6 months to 32.56 levels at 14 years 0 months; those for the girls ranged from 2.91 levels at 3 years to 26.11 levels at 13 years 3 months. The mean difference in levels at each age interval was 15.27 levels for the boys and 15.91 levels for the girls. The maximum mean developmental levels reached by the boys and girls with nutritive failure were 140 and 130 attained at ages 15 years 6 months and 15 years 3 months respectively. The control boys and control girls reached the corresponding identical mean developmental levels at 13 years 3 months and 12 years 9 months respectively.

The curves denoting the mean speed of growth for each sex in each group are shown in Figure 1. The mean pathway followed by the control boys ran between the 2 per cent and 15 per cent auxodrome from 3 years to 6 years, along the 15 per cent auxodrome from 6 years to 9 years 9 months and between the 15 per cent and 67 per cent auxodrome between 9 years 9 months and 15 years 9 months. The mean curve of the boys with nutritive failure paralleled that of the control boys until 13 years after which the curves diverged. The pathway followed by this curve started between the 15 per cent and 67 per cent auxodrome and drifted progressively to the right, crossing the 67 per cent auxodrome at 7 years 3 months and the 82 per cent auxodrome at 13 years 8 months. The mean pathway of the control

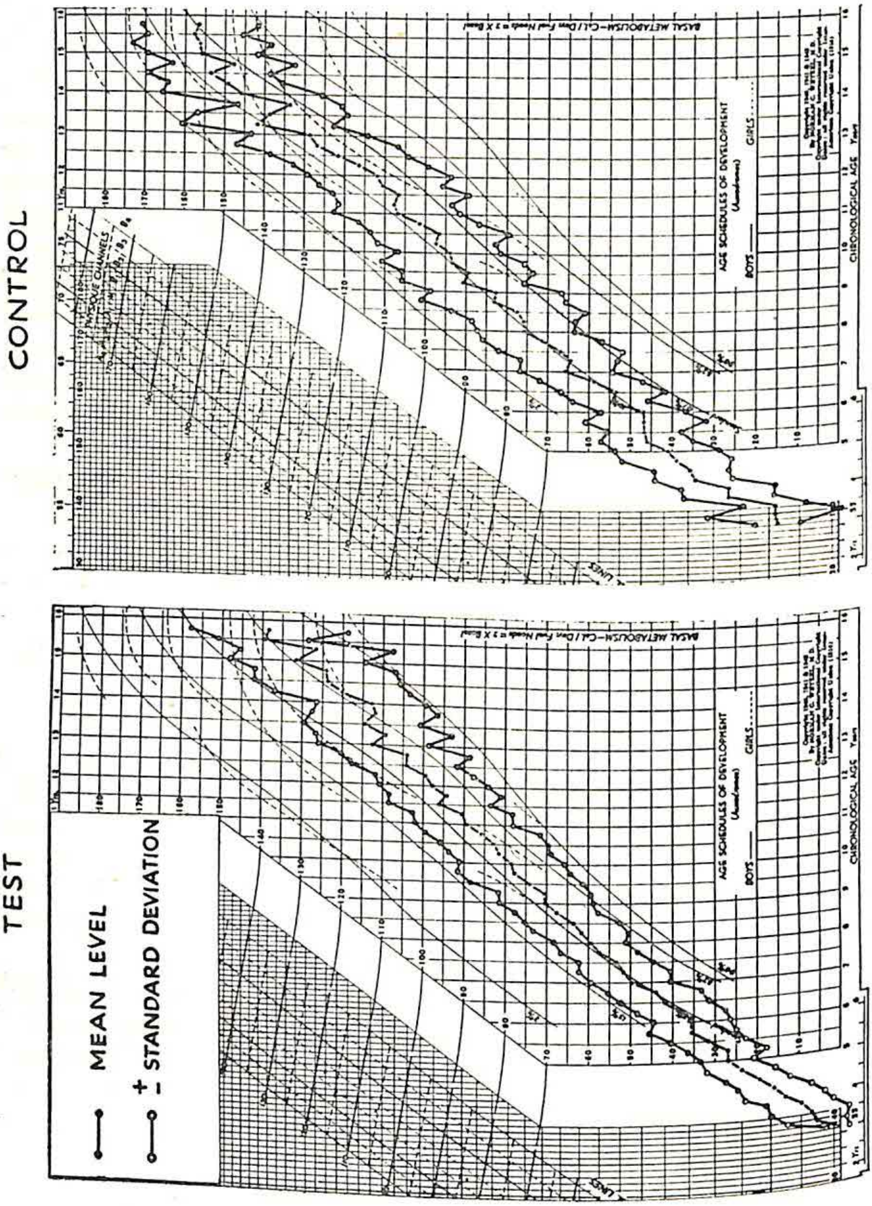

FIGURE 2—Mean isodevelopmental levels and standard deviations of test and control boys.

boys was greater than plus one standard deviation removed from the mean pathway of the boys with nutritive failure throughout the age range included in this study (Figure 2). In contrast, the mean pathway followed by the boys with nutritive failure was either equal to or slightly below the minus one standard deviation line derived from the mean curve of the boys in the control group.

The mean auxodrome followed by the control girls vacillated along the 15 per cent line or between the 15 per cent and 67 per cent lines from 3 years to 11 years 3 months, after which it drifted to the right and ran out its course along the 67 per cent auxodrome line. The mean of the girls with nutritive failure followed a course considerably slower than that of the girls in the control group. The two curves showed a slight but progressive divergence throughout the age range of the study. Starting to the left of the 67 per cent line, the mean curve for the undernourished girls crossed the 67 per cent line at 6 years, crossed the 82 per cent line at 11 years, and ran out its course between the 82 per cent and 98 per cent lines. The mean pathway followed by the control girls exceeded that of the undernourished girls throughout the middle age range by more than plus one standard deviation and was just above or just below the plus one standard deviation line in the upper and lower age ranges (Figure 3). In contrast, the pathway taken by the mean curve for the girls with nutritive failure vacillated throughout its entire course about the minus one standard deviation line developed from the mean curve for the control girls.

DISCUSSION

The degree to which chronic nutritive failure affects the growth progress of a child is determined by the interplay of genetic and environmental influences. Although these influences are highly specific, the use of ethnically identical groups of children from the same geographical area permits the derivation of certain general relationships between the growth progress of normal children and children with chronic nutritive failure. Thus, a comparison of the mean heights and weights of two such groups of children between 3 years of age and 15 years 9 months of age showed that the greatest amount of growth lag in boys with chronic nutritive failure occurs prior to 3 years of age, during the post-pubescent period and during the early adolescent period. Girls with chronic nutritive failure undergo a progressive lag in weight which begins prior to 3 years of age and continues through early adolescence, while the height lag present at 3 years of age remains relatively constant throughout the same period.

As measured by the Wetzel Grid, the mean speed of growth of the control children who served as the reference group was considerably greater than the Wetzel "normal" during the period of childhood, and substantially greater than the mean speed of growth of the children with nutritive failure

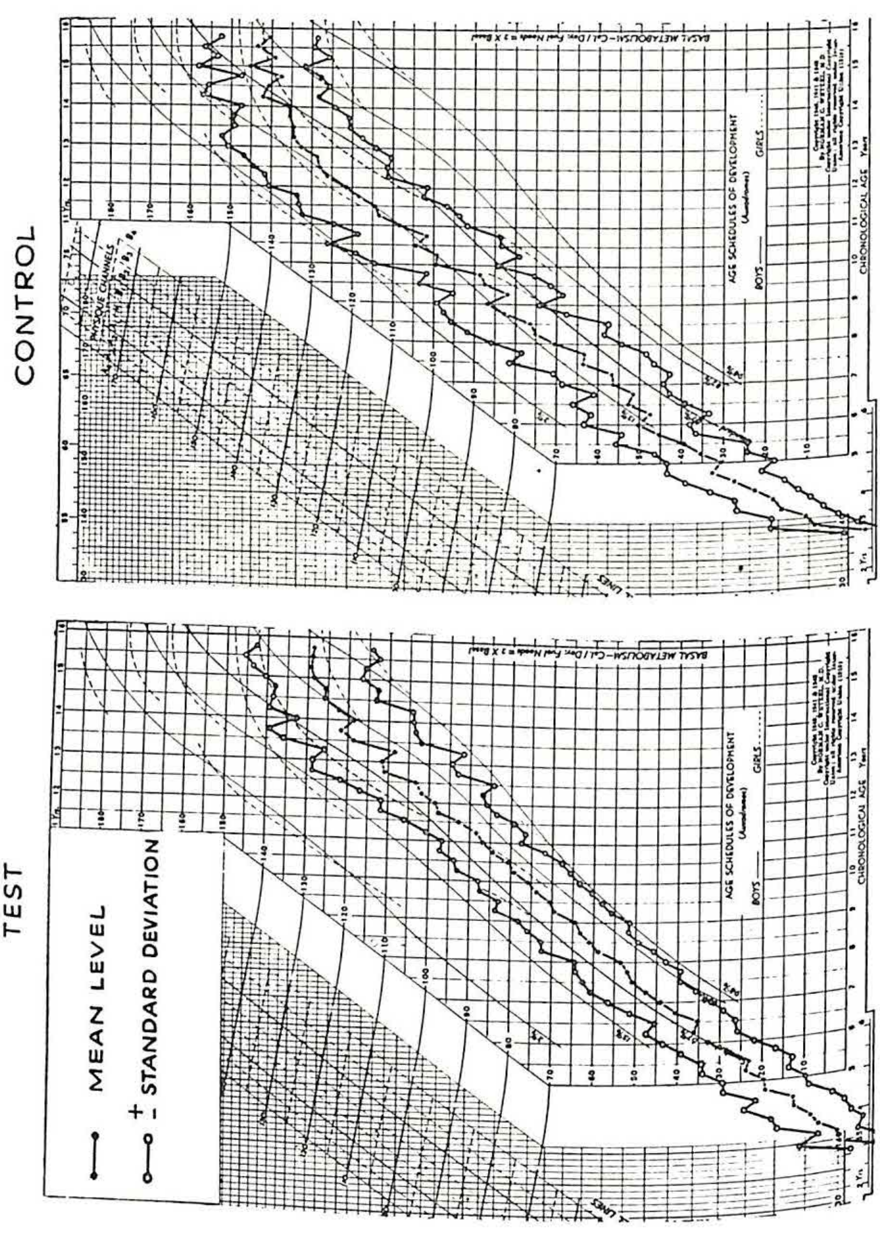

FIGURE 3—Mean isodevelopmental levels and standard deviations of test ——— and control ······ girls.

in the entire age range included in this investigation. The mean curves denoting the speed of growth of the reference group and of the group with nutritive failure were characterized by a drift to the right, a change indicative of a slowing in the speed of growth with increasing age. This drift was much more pronounced in the group with nutritive failure than in the reference group.

The height, weight and speed of growth values of the individual children in both groups showed considerable overlapping, a finding which decreased in prevalence at the higher ages. Overlapping in height and in speed of growth occurred more frequently than in weight, despite the lesser dispersion of height values about the means as compared to weight values. This observation, together with the large differences between the mean weight curves of the groups with and without nutritive failure suggest that the same degree of undernutrition exerts a greater retarding influence on weight progress than on height progress. Because of the overlapping noted between the individual values in the two groups of children, however, the superficial and more obvious manifestations of growth failure resulting from chronic undernutrition often may be obscured by the intensity of the inherent growth-promoting factors operating within a child.

Summary and Conclusions

A total of 8774 examinations were made on 2965 children ranging in age from 2 years 11 months to 15 years 11 months in the decade between 1942 and 1952. (These children were not included in the supplementation program of the Nutrition Clinic.) Five hundred and sixty-one children had clinical evidence of nutritive failure. By comparing the height and weight values of these children with those of the 2404 ethnically identical children without nutritive failure, it was found that:

1. In boys and girls with nutritive failure a substantial lag in height and in body weight is present by the third year of age. Thereafter, the weight lag increases progressively in both boys and girls with nutritive failure.
2. The height lag in the boys with nutritive failure becomes progressively greater after three years of age whereas that in girls remains fairly constant.
3. The mean speed of growth as determined by the Wetzel Grid is greater in the children without nutritive failure than in the group with nutritive failure.
4. The mean speed of growth declines in both groups as their ages increase. When plotted on the Wetzel Grid there is a progressive drift to the right in the mean curves on the auxodrome panel from 3 to 16 years of age.

As striking as were the differences between the mean height, weight and speed of growth values between the groups with and without nutritive failure, individual children showed overlapping at each age. The mean curves for height, weight and speed of growth in the group without nutritive failure approximated the corresponding plus one standard deviation lines of the group with nutritive failure. Conversely, the mean curves of the group with nutritive failure approximated the minus one standard deviation lines of the group without nutritive failure.

These studies show that while failure to reach the average height, weight or speed of growth for a particular sex at a particular age is suggestive of poor quality growth due to faulty nutrition, corroborative clinical evidence is essential in the final evaluation of the nutritional status of the child.

REFERENCES

1. DREIZEN, S., MANN, A. W., and SPIES, T. D. Seasonal incidence of retarded growth in children with nutritive failure. *Lancet*, 1948, 1, 175-177.
2. DREIZEN, S., CURRIE, CATHERINE, GILLEY, ELLIE JO, and SPIES, T. D. The effect of milk suplements on the growth of children with nutritive failure: II. Height and weight changes. *Growth*, 1950, 14, 189-211.
3. MANN, A. W., DREIZEN, S., SPIES, T. D., and PYLE, S. I. The determination of status and progress in children with nutritive failure. *J. Pediat.*, 1947, 31, 161-171.
4. MANN, A. W., DREIZEN, S., PYLE, S. I. and SPIES, T. D. The Red Graph and the Wetzel Grid as methods of determining the symmetry of status and progress during growth. *J. Pediat.*, 1948, 32, 137-150.
5. SIMMONS, KATHERINE. The Brush Foundation study of child growth and development: II. Physical growth and development. *Monog. Soc. for Research in Child Develpm.*, 1944, 9, No. 1 (Whole No. 37).
6. SPIES, T. D. and DREIZEN, S. The effect of milk supplements on the growth of children with nutritive failure. *J. Pediat.*, 1949, 34, 393-413.
7. SPIES, T. D., DREIZEN, S., SNODGRASSE, R. M., PARKER, G. S., and CURRIE, C. The skeletal maturational progress of children with chronic nutritive failure given a dietary supplement of reconstituted milk solids. *Am. J. Dis. Child.*, in press.
8. WETZEL, N. C. Physical fitness in terms of physique, development and basal metabolism. *J. Amer. med. Assn.*, 1941, 116, 1187-1195.
9. WETZEL, N. C. Growth, (In) Glasser, Otto, Ed. *Medical Physics*, Chicago: Year Book Publishers, Inc., 1944, p. 513.

COMPARISON OF GROWTH IN HEIGHT AND WEIGHT BETWEEN ECTOMORPHIC AND MESOMORPHIC BOYS[1]

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Most of the early published growth studies were primarily concerned with the establishment of standards for height and weight for the average child within a given ethnic group or socio-economic level (1, 3, 5). More recently the emphasis has shifted to a consideration of the individual child and the problem of the interpretation of growth status in terms of the child's own pattern of development (6). Concurrently, the need for studies of growth patterns in children of different body types has been realized in many quarters. With the introduction by Sheldon (4) of a method for classifying physique by somatotype components, research in child growth has been provided with a powerful new tool for describing physical differences. The present investigation has made use of the somatotyping technique for selecting subjects for a study comparing the visible physical growth of two groups of young men of contrasting physical build. Chosen for study were a group of predominant ectomorphs characterized by linearity and delicacy of body structure and a group of predominant mesomorphs with pronounced muscular development and ruggedness of structure. The purpose of the investigation was to determine whether the records of height and weight for the two groups indicated the same contrast in physical build throughout the growth period as was observed at the young adult state.

The Data

All subjects for this study were formerly enrolled in the Brush Foundation series. The Brush Foundation under the direction of T. Wingate Todd collected developmental data on a large series of Cleveland children from an economically and socially homogeneous population during the years 1928 to 1942. A majority of these same children have also been subjects in the dento-facial growth study directed by Dr. Holly Broadbent of the Bolton Fund Study. In 1951 a group of 125 boys from this series, now young adults, were photographed for a somatotype study. From the somatotypes two groups with contrasting physical characteristics were selected for a comparative study of height and weight during the growth period

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[1] We are indebted to Dr. Holly Broadbent for permission to use certain height and weight data collected in the Bolton Study and to Dr. Idell Pyle for helpful suggestions and criticism.

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from 2 to 17 years of age. The members of one group were predominantly mesomorphic each with a rating of five or higher in the second component of the somatotype, the other series was composed of ectomorphs, each member of which had been given a rating of five or more in the third component. To insure as great a contrast in physical type as possible between the two series, the mesomorphs were restricted only to those who showed a rating of three or less in the third component and except for three cases the ectomorphs all showed a rating of three or below in the second component. Of the three exceptions among the ectomorphs two were rated a four in mesomorphy and one was classified as a three and one-half in this component. Figure 1 shows the somatotype distribution for the two compared groups. The records of height and weight taken during childhood were obtained from the files of the Brush Foundation Study and the Bolton Study. There was no evidence from the histories that any of these boys

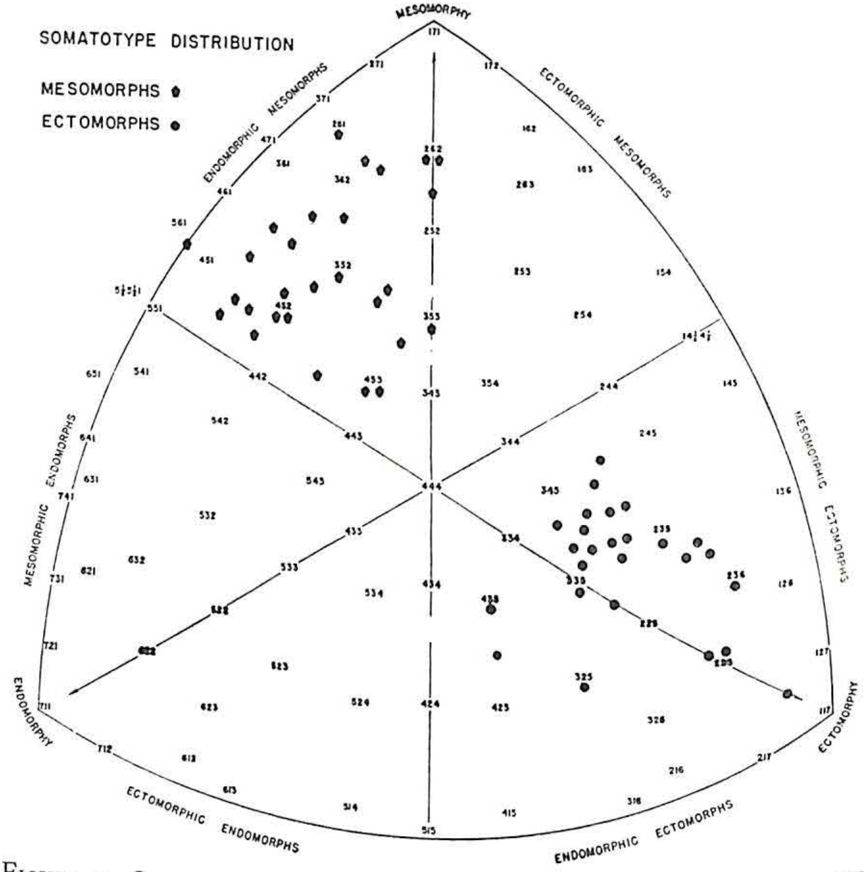

FIGURE 1—Somatotype distribution of the 26 ectomorphs and 28 mesomorphs used as subjects in this study.

had had any serious illness which would have permanently altered physical growth. Furthermore, each subject was in a normal state of health when somatotyped.

Measurements of height and weight were made during childhood at yearly intervals within a week of the birthday. Height was measured by an anthropometer of the Martin design with the child standing on the floor erect as possible, the shoes removed. For the statistics in this analysis the height measurements have been converted from millimeters to inches and tenths of inches. Weight was registered in pounds on a Fairbanks scale after removal of shoes but not of clothes.

The mesomorphs are represented by 28 subjects and the ectomorphs by 26. Unfortunately, only a few members of each series were followed throughout the full 17 years in the Brush and Bolton studies and in some instances there are gaps of one or two years in the records. For these reasons the number of subjects at the different age levels varies considerably and in many cases is far less than the total number in each series.

RESULTS

The mean somatotype component values for the series of ectomorphs ($N = 26$) and mesomorphs ($N = 28$) as revealed at the time they were photographed are as follows:

	Component I (Endomorphy)	*Component II* (Mesomorphy)	*Component III* (Ectomorphy)
Ectomorphs	2.65	3.04	5.21
Mesomorphs	3.46	5.36	2.02

The mean age, height, nude weight and height over cube root of weight ratio for each series at the time the somatotype photographs were taken are as follows:

	Age (Years)	*Stature* (Inches)	*Weight* (Pounds)	*Height / Cube Root of Weight*
Ectomorphs	20.8	71.4	142.0	13.73
Mesomorphs ...	21.6	69.1	168.7	12.53

Both groups averaged about the same age at that time, 21 years, with an age range from 16 to 30 years for each series. At the mean age of 21 years the ectomorphs averaged 2.3 inches taller and 26.7 pounds lighter in weight than the mesomorphs. This contrast in body size and bulk is reflected in the great difference in the mean values for the height over cube root of of weight index. Such a difference is to be expected since the ectomorphs were selected because of their linearity and delicacy of structure whereas the mesomorphs were chosen because of their pronounced muscular development and ruggedness of structure.

The results of the comparisons of the height and weight data for the two series are shown in the following series of graphs. In these graphs the arrow symbol indicates that the differences of means at the specified age is statistically significant.

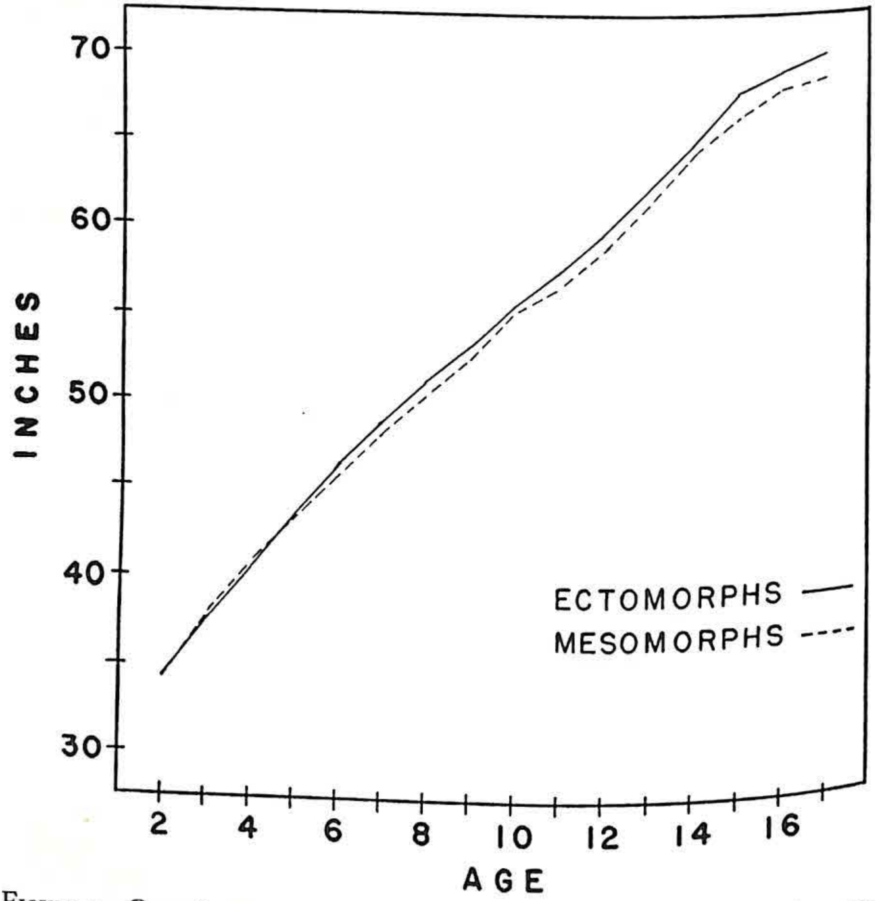

FIGURE 2—Growth curves in average stature for the ectomorphs and mesomorphs from 2 to 17 years of age.

Figure 2 shows the growth in height of the two groups of boys. It will be seen that from ages 2 to 4 years the mesomorphs average slightly taller than the ectomorphs but that from age 5 through 17 the reverse is true. Although the ectomorphs average about one-half inch taller than the mesomorphs at ages 6 to 10 years and as much as one and three-quarters inches taller at age 17 years, the differences of means between the two groups does not attain the level of statistical significance at any age period.

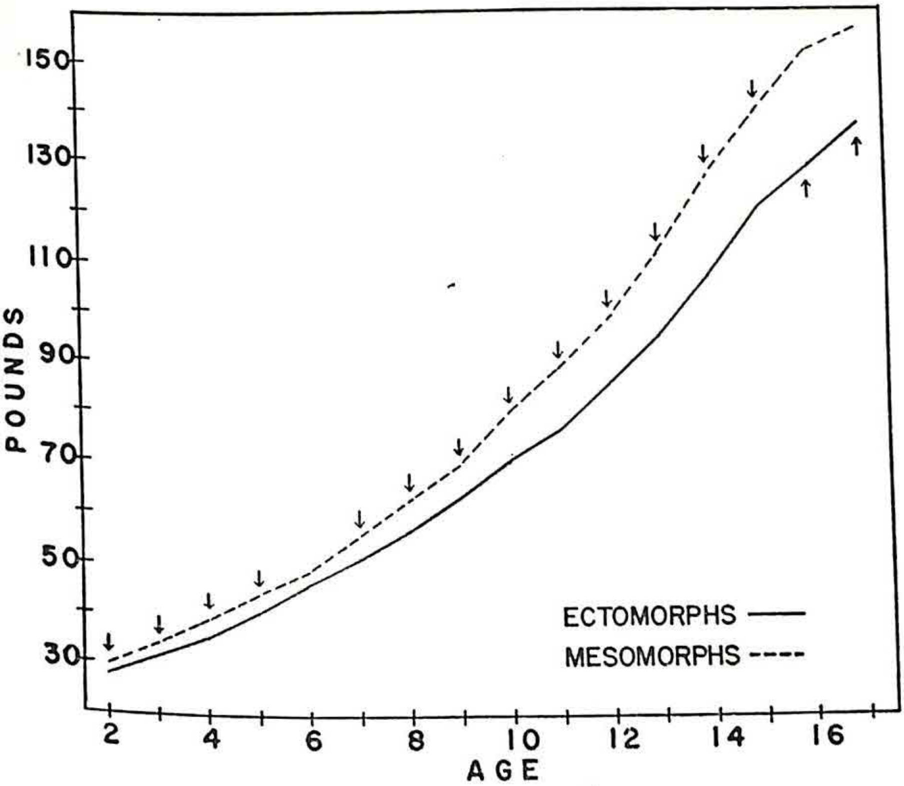

FIGURE 3—Growth curves in average weight for the ectomorphs and mesomorphs from 2 to 17 years of age.

A consideration of Figure 3 which shows the weight curves for the two compared series, reveals that the mesomorphs are heavier than the ectomorphs at every age from 2 through 17 years. The difference of means is statistically significant at each age level, except at age 6 years. There is a fairly steady increase of weight superiority in the mesomorphs from about two pounds at age 2 to between 16 and 23 pounds in the age span from 13 to 17 years. The mean weight difference at age 21, as noted above, was almost 27 pounds.

The curves for the height over cube root of weight ratios are shown in Figure 4. Since the ectomorphs average somewhat taller and considerably lighter in weight throughout most of the growth span it is not surprising that the mean height-weight ratios of the ectomorphs should be significantly higher than those of mesomorphs throughout this entire period.

There is a steady elevation in the mean height-weight index for both groups from age 2 to about the beginning of adolescence. Among the ectomorphs there is a leveling off in the mean index through the age span 11

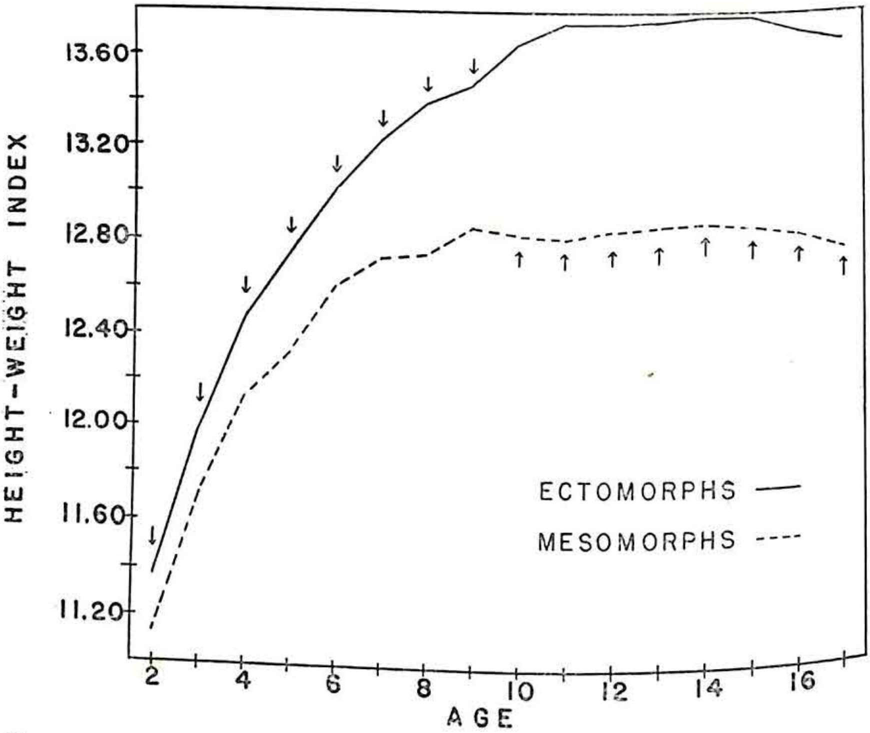

FIGURE 4—Average height over cube root of weight index at the various age levels from 2 to 17 years for the ectomorphs and mesomorphs.

to 15 years with a slight drop thereafter. The same phenomenon occurs in the mesomorphic series but the leveling off process begins two years earlier at age 9 years. In the case of the ectomorphs it appears that the relationship between height and weight remains quite constant from age 11, throughout the teens and possibly on into the third decade of life. As shown previously, the mean index for the ectomorphs at average age 21 years was 13.73. Among the mesomorphs the plateauing of this mean index covers only the years 9 to 15 indicating a fairly constant ratio between height and weight for this period, but the drop in the index after age 15 suggests that these boys are adding weight more rapidly in the late teens. Their mean height-weight ratio falls to 12.63 at average age 21 years.

The curves for the average annual increments in height for the two series of boys are given in Figure 5. In both groups the mean yearly increment in stature decreases rather steadily from age 2-3 years to age 10-11 years, although almost every year during this period the ectomorphs increase their stature slightly more than do the mesomorphs. From ages 10 to 14 years the picture is reversed and for this period the mesomorphs show a greater yearly increase in height. The puberal growth spurt appears to start at

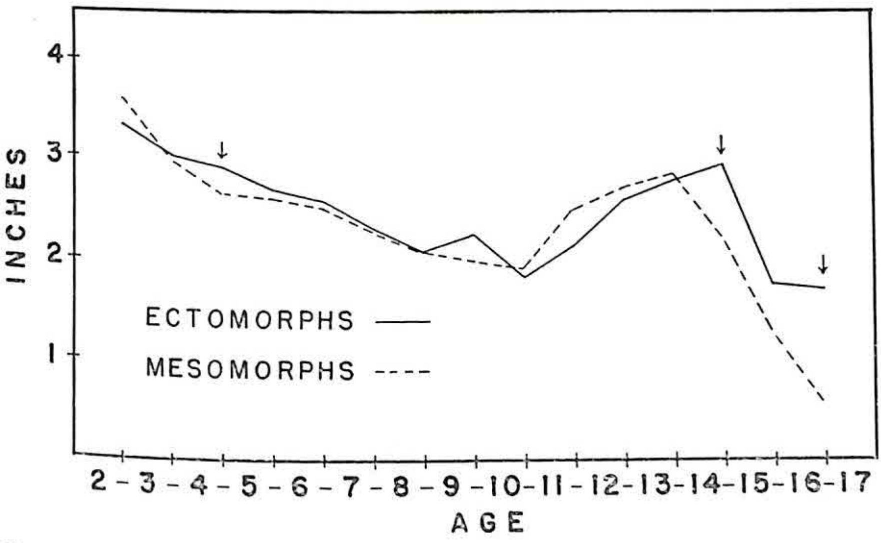

FIGURE 5—Mean annual increments of stature for the ectomorphs and mesomorphs for ages 2-3 years through 16-17 years.

about the same time (age 10 to 11 years) in both groups but the greatest mean yearly increment in height occurs during the year 13 to 14 among the mesomorphs and at age 14-15 for the ectomorphs. After reaching their respective peaks, both groups fall off sharply although the mean yearly increase in stature remains at a higher level for a longer period of time among the ectomorphs than among the mesomorphs. The inference to be drawn from this is that the ectomorphs continue to grow over a greater length of time than do the mesomorphs.

Although the trends in the mean yearly increments in stature present a different picture for the two groups, for the most part the differences of means at corresponding age levels are not statistically significant. They reach the level of significance only at ages 4-5, 14-15, and 16-17 years.

The curves showing the mean yearly increases in weight for both series are presented in Figure 6. Here it is seen that the year to year increment in weight is consistently higher for the mesomorphs than for the ectomorphs.. The difference of means attains statistical significance for ages 6-7, 9-10, 10-11, and 11-12 and approaches significance at 13-14 years. For the mesomorphs the mean increase in weight gets larger each successive year (except for age 5 to 6) until a maximum is reached at age 13-14 years. For the ectomorphs there is a fairly steady rise in the mean value until age 8-9 years and then for a two year period the mean weight increase falls off slightly. It picks up again from ages 10-11 and 11-12 years with the sharpest rise between 11-12 and 12-13 years. The peak increase occurs at age 14-15 years for this group. The mean increase falls off rapidly in both

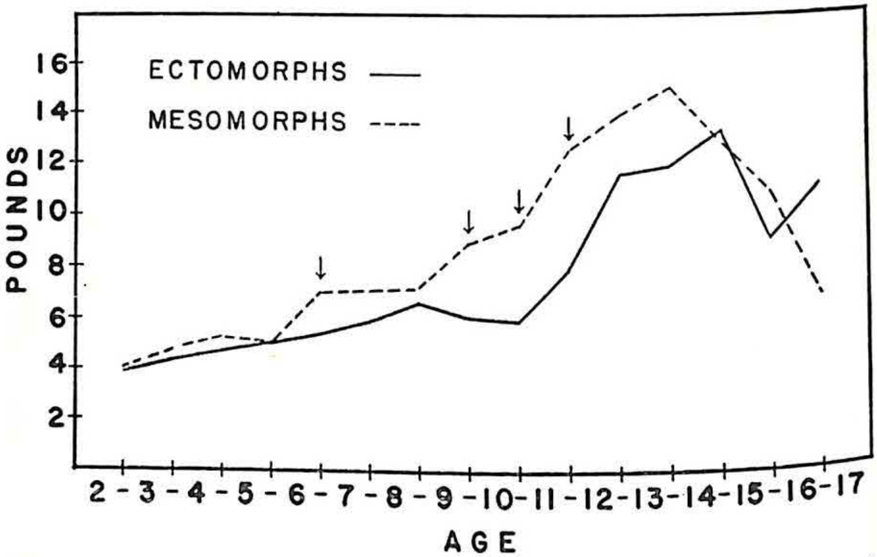

Figure 6—Mean annual increments of weight for the ectomorphs and mesomorphs for ages 2-3 years through 16-17 years.

groups after their respective peak periods although the value rises again among the ectomorphs between 15-16 and 16-17 years.

A further method for comparing growth status in the two series is shown in Figure 7. Here are plotted the mean percentages of adult stature attained at each age for both the ectomorph and the mesomorph series. For these calculations the level of adult stature was taken as of age 18 years or above. The few subjects who had not yet reached their eighteenth birthday at the time they were somatotyped are not included in this part of the study.

The results here show that at every age the mesomorphs collectively have attained a higher percentage of their ultimate adult stature as compared to the ectomorphs. Furthermore, the difference of means surpasses the 4 per cent level of statistical significance at every age from 3 through 15 years. It would appear, then, that although the ectomorphs actually average taller than the mesomorphs at almost every age level, they consistently lag behind them in growth achieved relative to final adult stature throughout the entire growth period considered in this study.

Discussion

The results of this study appear to suggest that at least for ectomorphs and mesomorphs the somatotype remains relatively constant throughout childhood. A comparison of the growth data indicates that there are differences in body build between the ectomorphs and mesomorphs during childhood which are consistent with their somatotype classifications as young adults. Our ectomorphic young men were taller and both absolutely and relatively lighter in weight than our mesomorphic young men and these same differences in height and weight were found to be present at practically every age level during the growth span. These findings are perhaps not surprising in the light of what is already known from studies by Wetzel (7, 8) and others. Children in general appear to follow developmental pathways which are in large measure determined by their genetic

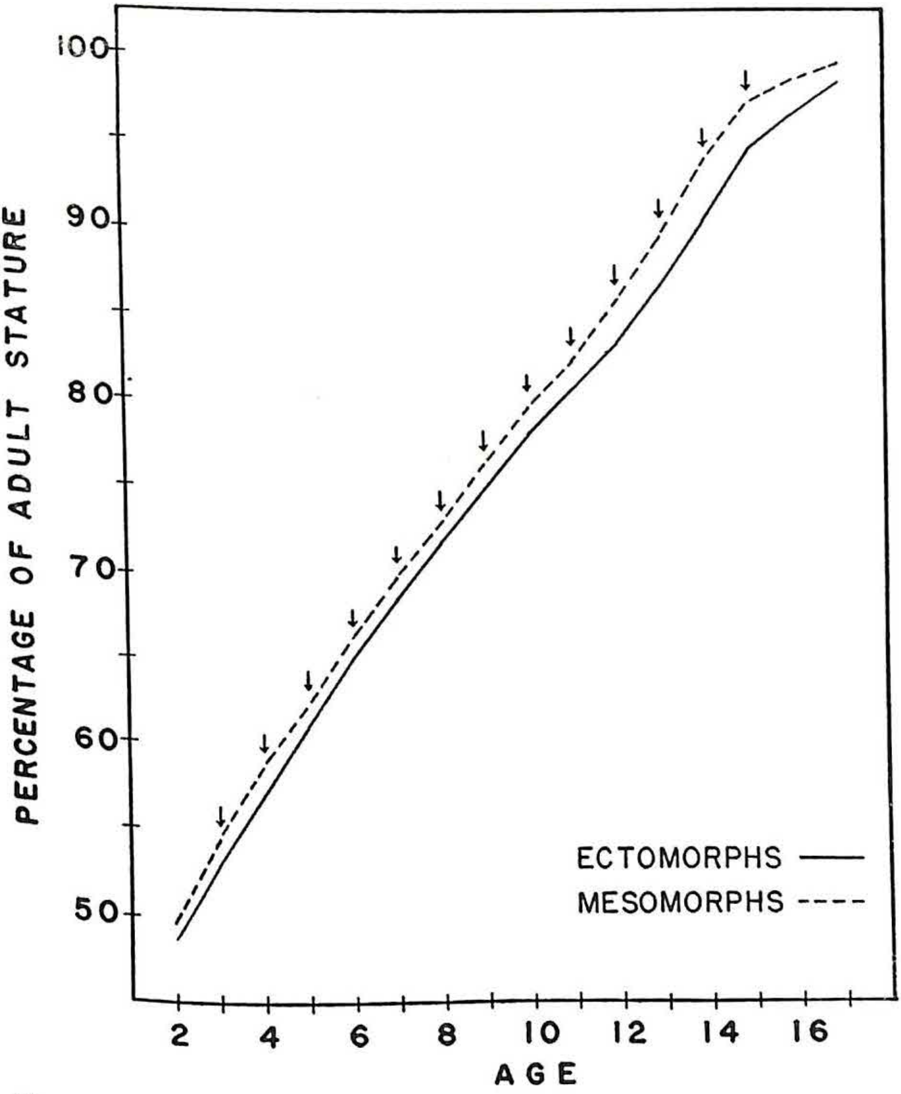

FIGURE 7—Mean percentage of adult stature attained by the ectomorphs and mesomorphs at various age levels from 2 to 17 years.

endowments. Apparently rugged, powerfully built mesomorphic children seldom end up as ectomorphic adults, nor do ectomorphic children, in the normal course of events, suddenly or even gradually change into heavy boned, muscular mesomorphic adults.

The results of this study show that throughout the growth period the greatest differences between the two groups occur in weight rather than in stature. Increase in height frequently is the accepted yardstick against which to assess relative growth status. Linear growth, however, is only one manifestation of the maturing organism; increase in size and bulk of the differential structures of the body are equally important as indicators of growth achieved.

Unanticipated, but perhaps the most interesting finding in this study, are the differences in the growth patterns observed between the two groups of boys. The shorter, heavier mesomorphs were found to grow faster and to mature earlier. The peak of their puberal spurt in both height and weight occurs on the average about one year earlier than it does among the ectomorphs. The overall growth period for the ectomorphs appears to cover a longer span of years whereas the attainment of adult stature for

TABLE I

COMPARISON OF MEAN PERCENTAGES OF ADULT STATURE ATTAINED AT THE DIFFERENT AGES FOR THE ECTOMORPHS, MESOMORPHS, AND DR. BAYLEY'S SERIES

Age	*Ectomorphs*	*Mesomorphs*	*Combined Ectomorphs and Mesomorphs*	*Dr. Bayley's Series*
2	48.7	49.5	49.2	48.5
3	53.0	54.4	53.7	53.0
4	56.8	58.6	57.7	57.6
5	65.0	62.4	61.6	61.7
6	61.0	66.2	65.5	65.5
7	68.6	69.8	69.2	69.3
8	71.9	73.0	72.4	72.0
9	74.9	76.2	75.5	75.0
10	77.9	79.5	78.8	78.1
11	80.6	82.1	81.4	81.0
12	83.2	85.6	84.4	83.8
13	86.6	89.6	88.2	87.3
14	90.4	93.9	92.4	91.5
15	94.5	97.2	95.8	95.5
16	96.4	98.4	97.6	97.7
17	98.2	99.3	98.8	98.8

the mesomorphs is achieved in a shorter length of time, and the process of growth seems to be more intensified particularly during adolescence. Growth in height ends sooner for the mesomorphs and the accompanying increase in body bulk (weight) begins earlier for them.

From the evidence presented here it appears that ectomorphic children grow more slowly than do mesomorphic children, at least in terms of growth achieved at any particular age relative to ultimate adult stature. In this respect, it is of interest to compare the mean values of percentage of adult stature attained at each age level for these two series with the figures published by Bayley (2) for a much larger series of boys presumably comprising a wide range of somatotypes (Table 1). Here we find that the mean percentages for the ectomorphs are consistently lower than those of Dr. Bayley's study and similarly the mean values for the mesomorphs are uniformly higher than the ones she cites. If we pool the figures for our two series, however, we find that the results more nearly agree with hers at almost every age level.

SUMMARY AND CONCLUSIONS

1. From a somatotype study of 125 young men, 26 ectomorphs and 28 mesomorphs were selected for a comparative study of their physical growth as indicated by measures of height and weight from 2 to 17 years of age. At the time they were somatotyped both groups averaged about 21 years of age and the ectomorphs averaged 2.3 inches taller and 26.7 pounds lighter in weight than the mesomorphs.

2. The results of the study showed that from 4 to 17 years of age the ectomorphs averaged consistently taller than the mesomorphs. The mesomorphs, however, averaged significantly heavier both absolutely and relatively than the ectomorphs at each age from 2 to 17 years.

3. A comparison of the growth curves showed that the mesomorphs reached their peak in puberal spurt in both height and weight on the average about one year earlier than the ectomorphs.

4. The ectomorphs were found to grow in height over a longer period of time than the mesomorphs.

5. The mesomorphs appeared to grow faster in that they consistently attained a higher percentage of adult stature at each age level as compared to the ectomorphs.

6. The conclusions are that the somatotype as indicated by measures of height and weight remains fairly constant, at least for ectomorphs and mesomorphs, throughout childhood and well on into the young adult period. Since growth patterns for boys of contrasting body build are shown to be different, this finding indicates the desirability of further study of growth

patterns in childhood of different body types to open the way for more comprehensive research into the problems of individual growth and development.

REFERENCES

1. BALDWIN, B. T. The physical growth of children from birth to maturity. *Univ, of Iowa stud., Stud. in Child Welfare,* 1921, 1, No. 1.
2. BAYLEY, NANCY. How tall will your child be? *Parent's Mag.,* 1947, August 22, 24-25.
3. MEREDITH, H. V. and STODDARD, G. O. Physical growth from birth to maturity. *Review Educ. Res.,* 1936, 6, 54-84.
4. SHELDON, W. H., STEVENS, S. S. and TUCKER, W. B. *The varieties of human physique.* New York: Harper, 1940.
5. SIMMONS, KATHERINE and TODD, T. W. Growth of well children: analysis of stature and weight, 3 months to 13 years. *Growth,* 1938, 2, 93-134.
6. STOLZ, H., and STOLZ, L. M. *Somatic development of adolescent boys.* New York: Macmillan, 1951.
7. WETZEL, N. C. Physical fitness in terms of physique, development and basal metabolism. *J. Amer. med. Assn.,* 1941, 116, 1187-1195.
8. WETZEL, N. C. Assessing the physical condition of children. *J. Pediat.,* 1943, 22, 82-110; 208-225; 329-361.

THE SEX DIFFERENCE IN THE BASAL METABOLIC RATE

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with the assistance of RUTH V. HARPER [1]
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The existence of a sex difference in the basal oxygen consumption is a matter of considerable importance, both of itself and in its broader implications. Since boys have a higher oxygen consumption under basal conditions, beginning even before the eighth year (6, 7), separate norms for boys and girls obviously are necessary. The fact that the basal metabolic rate of the adult male appears to be so much higher than in the female bears upon sex differences in behavior, and in mortality and morbidity as well. Pearl, among others, has attributed the shorter life span of the male to his higher level of energy metabolism, or as Pearl termed it to his "faster rate of living."

But before accepting a causal relationship between the higher metabolism and the shortened life span of the male, it is well to be sure that the male does have a higher metabolic rate, after due corrections for body size and body composition. It is noteworthy that the large sex difference in oxygen consumption, observable by the early teens, lessens when correction is made for differences in body size, or in the extent of body surface. Even so, there is a residual difference in oxygen consumption which increases after the first decade, but stabilizes before the time of legal majority (6).

This residual difference is of especial interest since it parallels changes in body composition. Briefly stated, boys and girls are reasonably comparable in the proportions of fat and muscle until about the 11th year (10). Thereafter boys increase markedly in the proportion of muscle, while girls add a higher proportion of fat (9, 10). In the adult state this difference continues to be true (1, 12) and may even become quite exaggerated (5).

Now, the lean body mass, or more particularly the amount of skeletal muscle, appears to be the single largest determinant of the basal oxygen consumption (4, 8), with correlations between the two variables from 0.8 to 0.9. Thus, males and females or boys and girls of equivalent body weight may still differ considerably in the amount of muscle present, and therefore in basal oxygen consumption. Under these circumstances older boys and adult males could have a higher oxygen consumption per unit of mass simply because of their greater muscle content.

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To investigate this possibility we have assembled data on metabolism, body size, and muscle mass for boys and girls between the 6th and the 18th year of life. It is the purpose of this study to ascertain whether the sex difference in the basal metabolic rate is attributable to sexual dimorphism in size and internal composition.

METHODS AND MATERIALS

Basal metabolic determinations were made on 76 boys and 69 girls, all participants in the Fels Longitudinal Studies, under morning-fasting conditions using the Jones-Basal, a bellows-type oxygen-circulating machine. From the average of two runs, other than the trial run, the time required to consume one liter of oxygen was computed in each case. This value, in turn, was converted into calories per 24 hours as is commonly done.

In addition to the data on oxygen consumption, the following values were also recorded at the time of testing. Age (in years and months), stature (in centimeters), and weight with light underclothing (in kilograms). From these values the proportion *calories per kilogram* was computed for each averaged test result. Oxygen consumptions were not calculated as a percentage of expected values as done in clinical studies, since the actual values were needed throughout.

Measurements of leg musculature were obtained from lateral-leg roentgenograms, taken at a standard distance of 6 feet, as described by Reynolds (10). In each case, the maximum diameter of the muscle shadow was recorded as measured with a vernier micrometer (Fisher No. 12-130) following the technique described by Garn, Clark and Portray (4). No corrections were made for magnification, constant and under 3 per cent, and bone size was not subtracted out.

Using the available leg muscle measurements, a matched pair series was made up, matching boys and girls as closely as possible. In no case did the members of a pair differ by more than 2 mm. in leg muscle diameter, and the mean difference for the 27 pairs so matched was 0.05 mm., or less than 1 per cent of the average leg muscle diameter.

In making the calculations, two-year age groupings were used, and the means for each of 12 age-sex groups were calculated separately. Two of the graphic representations (Figures 2 and 3) employed logarithmic plots as described by Croxton and Cowden (3). Such plots were used both to simplify the illustrative process and to straighten trend lines where needed.

It was not the purpose of this study to present normative data, which has been done most adequately by the Carnegie group and more recently by Lewis and his associates (6, 7). However, the data may be considered representative of healthy native-born white children from Southwestern Ohio, and correspond closely to published data on similar groups.

FINDINGS

The sex difference in the basal metabolic rate was investigated first against the background of age changes. To do this, data on basal oxygen consumption were sorted by sex and age groups, as previously described. The mean values for the age groups thus showed the extent of age changes and the magnitude of sex differences.

TABLE I

OXYGEN CONSUMPTION, OXYGEN CONSUMPTION PER KILOGRAM, WEIGHT AND HEIGHT BY AGE AND SEX

Sex	*Age*	*N*	Height (cm) *Mean±S.D.*	Weight (kg) *Mean±S.D.*	O_2 per 24 Hrs *Mean±S.E.*	O_2 per Kg *Mean±S.E.*
Boys ..	6– 7 ..	42	124.4±4.8	24.3±3.3	1145±17.1	47.3±0.7
Girls ..	6– 7 ..	27	125.3±7.3	27.9±3.9	1095±19.4	46.6±0.9
Boys ..	8– 9 ..	39	136.0±4.5	30.8±4.4	1252±19.8	41.0±0.5
Girls ..	8– 9 ..	36	135.4±5.2	28.8±4.7	1167±19.6*	41.1±0.7
Boys ..	10–11 ..	29	145.2±5.3	36.6±6.1	1322±23.8	36.7±0.9
Girls ..	10–11 ..	36	145.7±6.8	35.8±6.3	1268±26.2	35.9±9.6
Boys ..	12–13 ..	33	155.7±9.5	47.6±9.6	1546±35.6	33.5±0.8
Girls ..	12–13 ..	40	156.4±7.5	44.3±6.8	1354±26.6*	30.7±0.6*
Boys ..	14–15 ..	33	170.0±7.5	60.8±9.9	1779±36.2	29.7±0.7
Girls ..	14–15 ..	38	160.2±7.7	52.4±7.9	1375±18.2*	26.8±0.6*
Boys ..	16–18 ..	28	177.8±4.8	70.6±7.5	1841±42.1	26.3±0.3
Girls ..	16–18 ..	28	162.9±6.6	54.7±8.1	1321±23.1*	24.7±0.7*

*Sex difference in oxygen consumption significant at $p = .05$ or better.

As shown in Table 1, and illustrated in Figure 1, basal oxygen consumption was at all age levels higher in the boys, though in the younger age groups the sex difference was not large. Beginning with an average of 1,145 calories per 24 hours in the age group 6-7, oxygen consumption in the boys rose to 1,841 calories per 24 hours in boys 16 and over. In contrast, in the same age range oxygen consumption rose from 1,095 calories per 24 hours in the youngest group to over 1,300 calories in the older girls. The nine-year increase in the boys (696 calories per 24 hours) represented a gain of 60 per cent. In the girls the increase amounted to 300 calories, half as much as in the boys, and slightly over 30 per cent on a percentage basis. Though both sexes exhibited an age-associated increase in basal oxygen consumption, the age increment was markedly greater in the boys.

Since the age-associated increases in oxygen consumption were at least in part due to increases in body size, admittedly greater in the boys, it was necessary to correct for age and sex differences in mass. To do this, all data

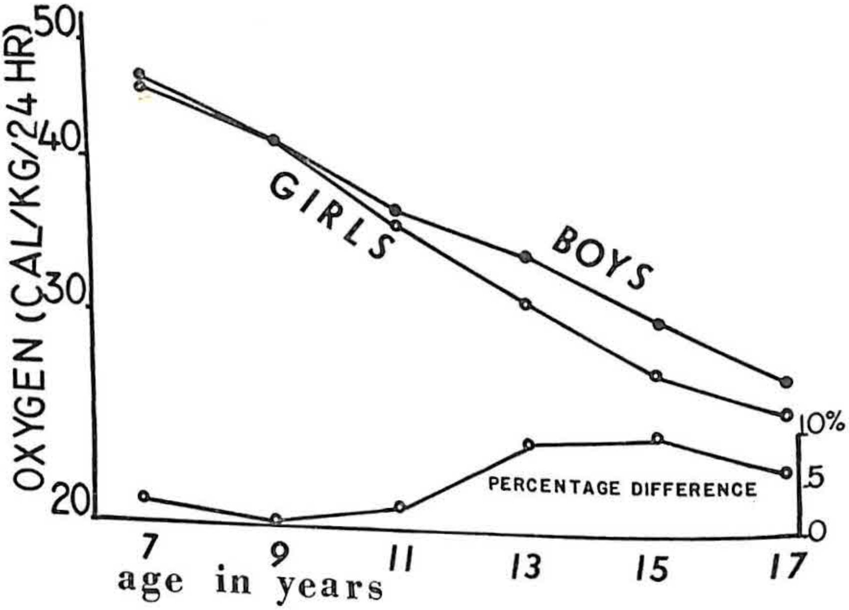

FIGURE 1—Age changes in basal oxygen consumption. Note the consistently higher oxygen consumption of the boys, and the disproportionate increase beginning early in the second decade.

were recomputed on a uniform basis as calories per kilogram of body weight. When this was done (Table 1) and plotted (as in Figure 2), the extent of sex differences in oxygen consumption was somewhat minimized. Both boys and girls exhibited the characteristic *decrease* in oxygen consumption per kilogram of body weight with increasing age and size. Nevertheless, oxygen consumption per kilogram of body weight continued higher in the boys at all age levels, and the rate of decrease was less in the boys aged 10 and over. Thus in the later years the sex difference in oxygen consumption per kilogram of body weight was as much as 3 calories per kilogram, or 10 per cent. Evidently the larger body mass, characteristic of the older boy, does not entirely account for the observed sex difference in basal oxygen consumption.

But since sexual dimorphism involves a difference in body composition as well as the greater body mass of the male, it was important to determine whether adequate correction for this sex difference would account for the difference in oxygen consumption. Accordingly the matched pair series was set up, wherein boys and girls were carefully matched in leg muscle diameter. In this way, comparability was assured for the amount of skeletal muscle, an important determinant of metabolic activity. However, though the 27 pairs of boys and girls were carefully matched in terms of

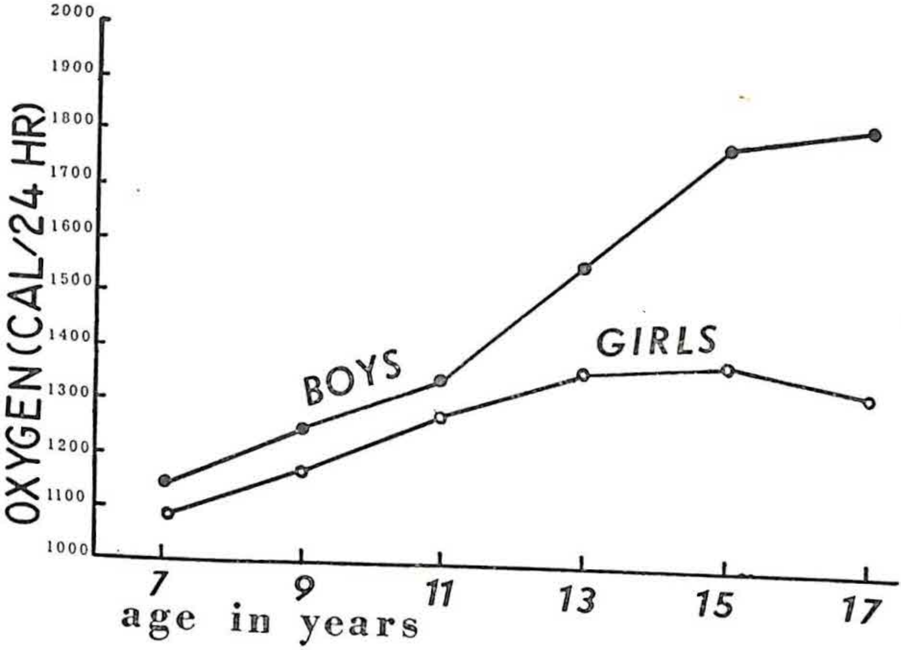

FIGURE 2—Age changes in oxygen consumed per kilogram of body weight. Teen-age boys and girls differ by as much as 10 per cent, indicating a higher level of oxygen consumption per unit of mass for the boys.

muscle size (Table 2) with a mean difference of less than 1 per cent, the sex difference in basal oxygen consumption was not eliminated. As shown in Figure 3, 66 per cent of the boys had a higher basal oxygen consumption than girls of comparable muscle mass. This was true also when computed on a per-kilogram basis. Pubertally and postpubertally *all* of the boys had a higher oxygen consumption under basal conditions than did girls paired with them on the basis of muscle size. Thus, while differences in muscle mass do have a marked effect on oxygen consumption, it cannot be said that such differences entirely account for the higher metabolic activity of the male. Boys and girls of equivalent muscle mass differ nearly as much in metabolic activity as boys and girls of equivalent body weight.

DISCUSSION

The findings in this study, as in others (6, 7), demonstrate the extent and the pattern of the sex difference in basal oxygen consumption. During childhood boys and girls are not markedly different in their average oxygen requirements in the basal (morning-fasting) state; still, oxygen consumption is consistently higher in the boys. However, well before the appearance of pigmented pubic hair, areolar changes, or alterations in the sebaceous activity of the skin, the sex difference in basal oxygen consumption increases. Even during the age span when girls exceed boys in stature, the boys have higher metabolic requirements. Though absolute oxygen consumption increases until at least the 16th year in both sexes, the rate of increase as well as the volume consumed is greater in the boys. Whereas the mean oxygen consumption for boys is scarcely 4 per cent above that

TABLE 2

OXYGEN CONSUMPTION OF BOYS AND GIRLS PAIRED ON THE BASIS OF MUSCLE SIZE

Pair No.	Leg Muscle (mm) *Boy*	*Girl*	*Diff*	Calories per 24 Hrs *Boy*	*Girl*	*Diff*	Calories per Kg *Boy*	*Girl*	*Diff*
1	73.3	74.7	—1.4	1210	1090	120	38.9	42.9	—4.0
2	74.8	74.8	0.0	1070	1246	—176	48.1	41.6	6.5
3	76.8	76.8	0.0	1059	1110	— 51	42.3	44.5	—2.2
4	75.8	77.1	—1.3	1317	1357	— 40	55.8	28.2	27.6
5	78.8	77.5	1.3	1294	1222	72	43.0	48.5	—5.5
6	78.1	79.1	—1.0	1374	1183	191	48.6	46.6	2.0
7	77.9	79.2	—1.3	1146	1340	—194	41.6	49.2	—7.6
8	82.1	80.4	1.7	1040	1236	—196	41.5	45.6	—4.1
9	78.9	80.9	—2.0	1275	1266	9	46.6	37.5	9.1
10	80.8	80.9	—0.1	1426	1360	66	41.1	40.5	0.6
11	82.3	82.2	0.1	1250	1114	136	49.2	43.1	6.1
12	84.5	84.5	0.0	1350	1390	— 40	40.7	41.4	—0.7
13	85.9	84.6	1.3	1340	1235	105	40.1	28.2	11.9
14	85.6	86.1	—0.5	1210	1310	—100	32.0	33.2	—1.2
15	88.2	88.2	0.0	1266	1226	40	34.1	34.4	—0.3
16	87.2	88.3	—1.1	1430	1236	194	40.1	24.4	15.7
17	90.7	88.7	2.0	1363	1159	204	42.6	23.2	19.4
18	90.4	91.2	—0.8	1250	1408	—158	38.1	34.9	3.2
19	90.9	91.5	—0.6	1342	1326	16	32.9	29.4	3.5
20	94.1	94.1	0.0	1326	1158	168	37.9	24.0	13.9
21	96.3	97.2	—0.9	1638	1280	358	34.4	27.9	6.5
22	97.9	97.7	0.2	1661	1466	195	24.0	28.1	—4.1
23	101.6	100.4	1.2	1484	1278	206	36.5	27.6	8.9
24	102.9	101.3	1.6	1732	1230	502	31.0	23.6	7.4
25	102.2	101.5	0.7	1357	1466	—109	34.5	25.5	9.0
26	106.7	105.2	1.5	1661	1427	234	28.7	24.6	4.1
27	114.3	113.5	0.8	1950	1693	257	27.9	25.4	2.5
Average	88.1	88.1	0.05	1364	1289	74.4*	39.0	34.2	4.2*

* Difference significant at $p = .001$ or better.

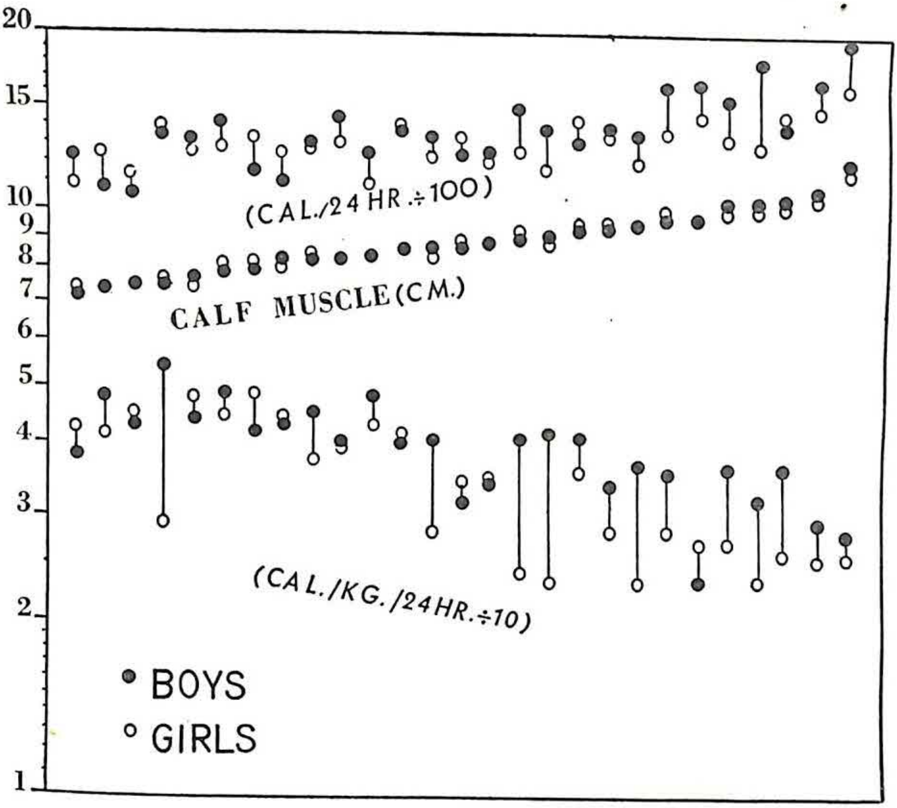

FIGURE 3—Metabolic data for 27 pairs of boys and girls matched on the basis of leg muscle diameter. Despite the closeness of the muscle matches, the boys still consume more oxygen and more oxygen per kilogram of body weight.

of girls during childhood, in the late teens the basal metabolic rate of boys is 30 per cent greater than that of girls. The necessity for different metabolic standards is thus evident.

But absolute values are misleading unless corrected for body size. By the early teens, boys average inches taller and pounds heavier than the girls. Being larger, they should have a higher oxygen consumption. Recalculating the data in terms of a uniform reference standard (such as weight or surface area) does reduce the sex difference somewhat, but does not eliminate it entirely. Over a ten year period basal oxygen consumption per kilogram of body weight drops nearly 50 per cent in both sexes. But it drops less rapidly in the male, as Lewis *et al.* (6) and others have noted, so that the oxygen consumption per unit of body weight is still about 10 per cent higher in nearly adult boys. Using weight or surface area as a reference standard eliminates some of the sex difference in the basal metabolic rate, but not all.

But equal weight or equivalent surface areas may mask differences in internal composition and this provides a possible explanation for the residual sex difference in basal oxygen consumption. As is now well known, boys differ from girls and men from women in the proportions of fat and muscle, and in the proportions of the several body fluids as well. As we have shown previously, muscle mass and oxygen consumption are highly correlated in this age group (4) and per unit of mass the male consists of more muscle with its high metabolic requirements and less of the metabolically less active fatty tissue. However, correcting for this difference in body composition does not eliminate the sex disparity in metabolism. A carefully matched series, pairing boys and girls almost exactly in calf-muscle size, still evidences the *usual* differences in oxygen consumption and in the *usual* direction. Despite the closeness of the matches (averaging within 1 per cent) both basal oxygen consumption and oxygen consumption per kilogram of body weight continue to be higher in the boys, and especially in the older boys. Boys tend to be bigger than girls. Boys, or at least older boys, contain more muscle and less fat than girls. Yet pound for pound, and pound of muscle for pound of muscle, the metabolism of the male exceeds that of the female, and to an increasing degree until the mature or "steady state" of growth and development.

Inasmuch as corrections for both body size and body composition fail to eliminate the familiar sex difference in the basal metabolic rate, it is well to consider other factors known to affect tissue metabolism. There is nothing at present that would suggest a higher level of thyroid activity in the male, though this cannot be discounted. But attention should be directed to the ketonic steroids (including the 17 ketosteroids) which rise above the minimum detectable levels at precisely the time when the metabolism curves begin to diverge (11). And it is known that many of these steroids are able to speed up the metabolic activity of muscle tissue. Here we have two possibilities. One is that ketonic steroids peculiar to the male underlie the differences in the basal metabolic rate observed here, and by many other workers. The other possibility is that quantitative differences in the level of metabolism-stimulating hormones are involved. Metabolic and endocrine studies on this group of boys and girls, which have been published elsewhere, favor the first alternative (2).

It should be emphasized, however, that the sex difference in metabolic activity is a real difference, and not just a byproduct of differences in size or internal composition. Though the male matures later than the female, his increased oxygen consumption begins early (pre-pubertally) and of course persists through adult life. The higher metabolic rate of the male may or may not account for the well-known sex differences in mortality and morbidity, or the familiar sex differences in overt behavior. But it is not something that can be factored away by the choice of a suitable reference standard.

SUMMARY

1. In order to determine whether the sex difference in the basal metabolic rate could be explained in terms of body size and body composition, 409 determinations of basal oxygen consumption were made on 76 boys and 69 girls, including 27 pairs matched on the basis of muscle size.

2. In the age span 6-17, the males increased in basal oxygen consumption from 1,145 calories per 24 hours to 1,841, an increase of 60 per cent. The girls showed an increase of only 30 per cent in the same period.

3. Correcting for body size through the use of a uniform reference standard (calories per kilogram), the magnitude of the sex differences was reduced. However, the boys still exhibited a higher metabolic activity, especially in the older groups, with differences up to 10 per cent.

4. Although matching on the basis of muscle mass satisfactorily corrected for sex differences in body composition (namely muscle mass), the discrepancy in oxygen consumption remained, especially in the older group. With a mean difference of only .05 mm. in muscle size, the mean difference in oxygen consumption for the pairs (74.4 calories per 24 hours) equalled 6 per cent.

5. It was concluded that the higher level of metabolic activity in the male is not entirely due to his greater body size, or to his higher proportion of muscle per unit of mass.

6. Attention was directed to the metabolism-stimulating effect of certain steroid hormones, which may underlie the residual sex difference in basal metabolism, and to the epidemiological implications of the higher level of metabolic activity in the male.

REFERENCES

1. BROZEK, J. Measuring nutriture. *Amer. J. phys. Anthrop.*, 1953, 11, 147-180.

2. CLARK, L. C., JR. and GARN, S. M. Relationship between ketosteroid excretion and basal oxygen consumption in children. *J. appl. Physiol.*, 1954, 6, 546-550.

3. CROXTON, F. E. and COWDEN, D. J. *Applied general statistics.* New York: Prentice-Hall, 1940.

4. GARN, S. M., CLARK, L. C., JR., and PORTRAY, R. Relationship between body composition and basal metabolic rate in children. *J. appl. Physiol.*, 1953, 6, 163-167.

5. GARN, S. M .and SAALBERG, J. I., Age and sex differences in the composition of the adult leg. *Human Biol.*, 1953, 25, 144-153.

6. Lewis, R. C., Duval, A. M. and Iliff, A. Effect of adolescence on basal metabolism of normal children. *Amer. J. Dis. Child.,* 1943, 66, 396-403.

7. Lewis, R. C., Duval, A. M. and Iliff, A. Standards for the basal metabolism of children from 2 to 15 years of age, inclusive. *J. Pediat.,* 1943, 23, 1-18.

8. Miller, A. T., Jr. and Blyth, C. S. Lean body mass as a metabolic reference standard. *J. appl. Physiol.,* 1953, 5, 311-316.

9. Reynolds, E. L. and Grote, P. Sex differences in the distribution of tissue components in the human leg from birth to maturity. *Anatomical Record,* 1948, 102, 45-53.

10. Reynolds, E. L. The distribution of subcutaneous fat in childhood and adolescence. *Monogr. Soc. Res. Child Develpm.,* 1950, Vol. XV, No. 2.

11. Talbot, N. B., Butler, A .M., Berman, R. A., Rodriguez, P. M. and MacLachlan, E. A. Excretion of 17 ketosteroids by normal and abnormal children. *Amer. J. Dis. Child.,* 1943, 65, 364-375.

12. Widdowson, E. M., McCance, R. A. and Spray, C. M. The chemical composition of the human body. *Clin. Sci.,* 1951, 10, 113-125.

SEASONAL VARIATIONS IN PHYSIOLOGICAL FUNCTIONS DURING ADOLESCENCE

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Several reports dealing with seasonal variations in physical (9) and psychological (8) development have already appeared from the Institute of Child Welfare. This article reports the result of an examination of five aspects of physiological development during adolescence for evidence of seasonal variation. The five physiological measures are BMR, systolic blood pressure, basal pulse rate, respiratory rate, and basal oral temperature.

METHOD

The data upon which this investigation is based were collected during a longitudinal study of adolescence.[1] The subjects and general procedure are described in detail in a preceding article (2). Specific techniques of measurement are as follows: BMR was determined by the Tissot open circuit technique.[2] Respiratory rate was counted for one minute twice during each of the three gas sampling periods. Blood pressure was recorded at the first sound (auscultatory technique). Pulse rate was counted for a full minute. Oral temperature was taken for two minutes and then the thermometer returned for one minute and re-read for reliability. The entire procedure was repeated the following day.

Blood pressure and pulse rate were lowest during the first and second determinations made with the subject supine (18). Thus the average of these four measures (two each day) has been used since it presumably represents the closest approximation to truly basal measures. The mean of four measures was also used for body temperature. For BMR and respiratory rate the average of all six determinations has been used (16, 17).

RESULTS

Since it is known that there are individual and chronological variations in these physiological processes, it seemed poor tactics to search for clear-cut evidence of individual seasonal variations. Such an attempt also seemed unfeasible because of the fact that only two measures a year were taken. Finally, subjects who were measured only once a year would have had to be excluded, since in most cases the measures were taken in the same or

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[1] Harold E. Jones directed the investigation. The physiological program was under the supervision of Nathan W. Shock. A general description of the study is to be found in (7).

[2] Details of the procedure are given in (17).

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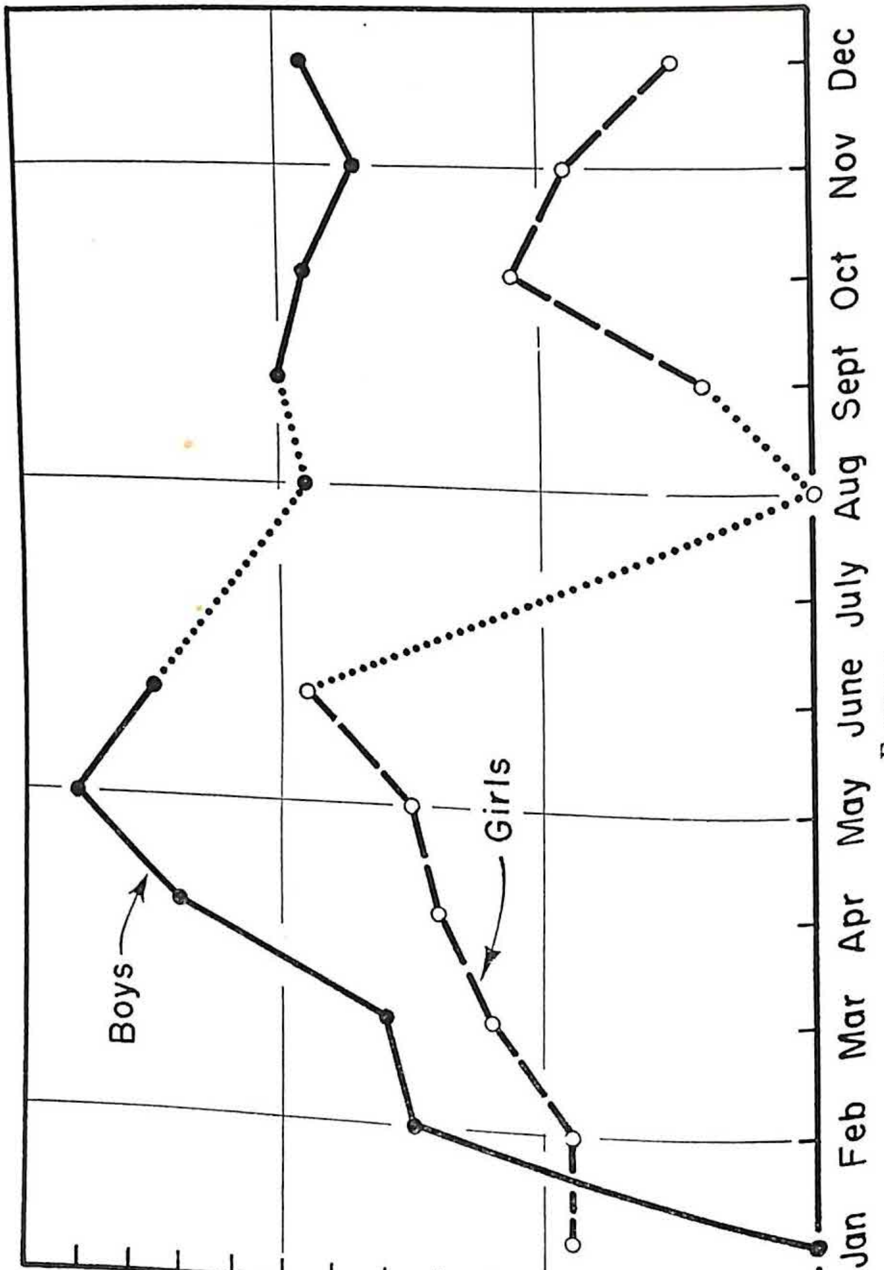
.30
.20
.10
00
Deviation from lowest month (degrees F)
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Boys
Girls

FIGURE 1

adjacent months of consecutive years. Consequently, it was decided to group the data for all subjects for all years; that is, to combine all measures in a given month regardless of the subjects on whom they were made and regardless of the year in which they were made. Since most subjects missed one or more testing periods and also because subjects measured originally in (say) March and September were sometimes measured the following year in (say) April and October, there is a partial and varying overlap from month to month when the data are combined by months over all years as outlined above.

In order to overcome the statistical difficulties which arise from the overlap described above, two corrections were made in each measure for each child before the analysis of seasonal variations was undertaken.[3] First, an age correction was made. The regression on age of the variable under consideration was determined for each sex by the method of least squares, except for oral temperature in girls where linearity could not be assumed (2). This curve was fitted by eye. The mean at an arbitrary age was taken as a reference point. Then each measure for each child was corrected for the child's deviation from this age.

Following the age correction, the correction for individual differences was applied. Each measure for each child was corrected in terms of the deviation of the mean of that child's measures from an arbitrary reference point. For example, assume that the individual utilized as an arbitrary reference point for BMR has an average BMR of 42 calories per square meter per hour (after having been corrected for age deviations). Assume that the mean of a particular subject's BMR measures (each of which has been corrected for deviations from an arbitrary age) is 39, then each measure of BMR for this subject would be increased by three.

The first correction removes the systematic effect of age. The second removes the systematic effect of individual differences. Identical procedures were followed for all five physiological measures.

The twice corrected means for all five measures by month are given in Table 1. In Figures 1, 2, and 3 the deviations of the twice-corrected means are plotted as deviations from the lowest month. This method of plotting the data was chosen arbitrarily, since the twice-corrected means do not represent the true values of the measures at each month. Figures for respiratory rate and blood pressure have been omitted since in these functions there was no indication of seasonal variations.

Let us first consider Figure 1 and the question of seasonal variation in oral temperature. In spite of some irregularity in the curves, there is a rather clear general trend for oral temperature to rise during the spring and to decline during autumn. The "*F*" for seasonal variation in boys is 2.39. With 10 and 513 degrees of freedom this value is significant at the 1 per

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[3] Dr. Rheem F. Jarrett suggested this approximate statistical procedure.

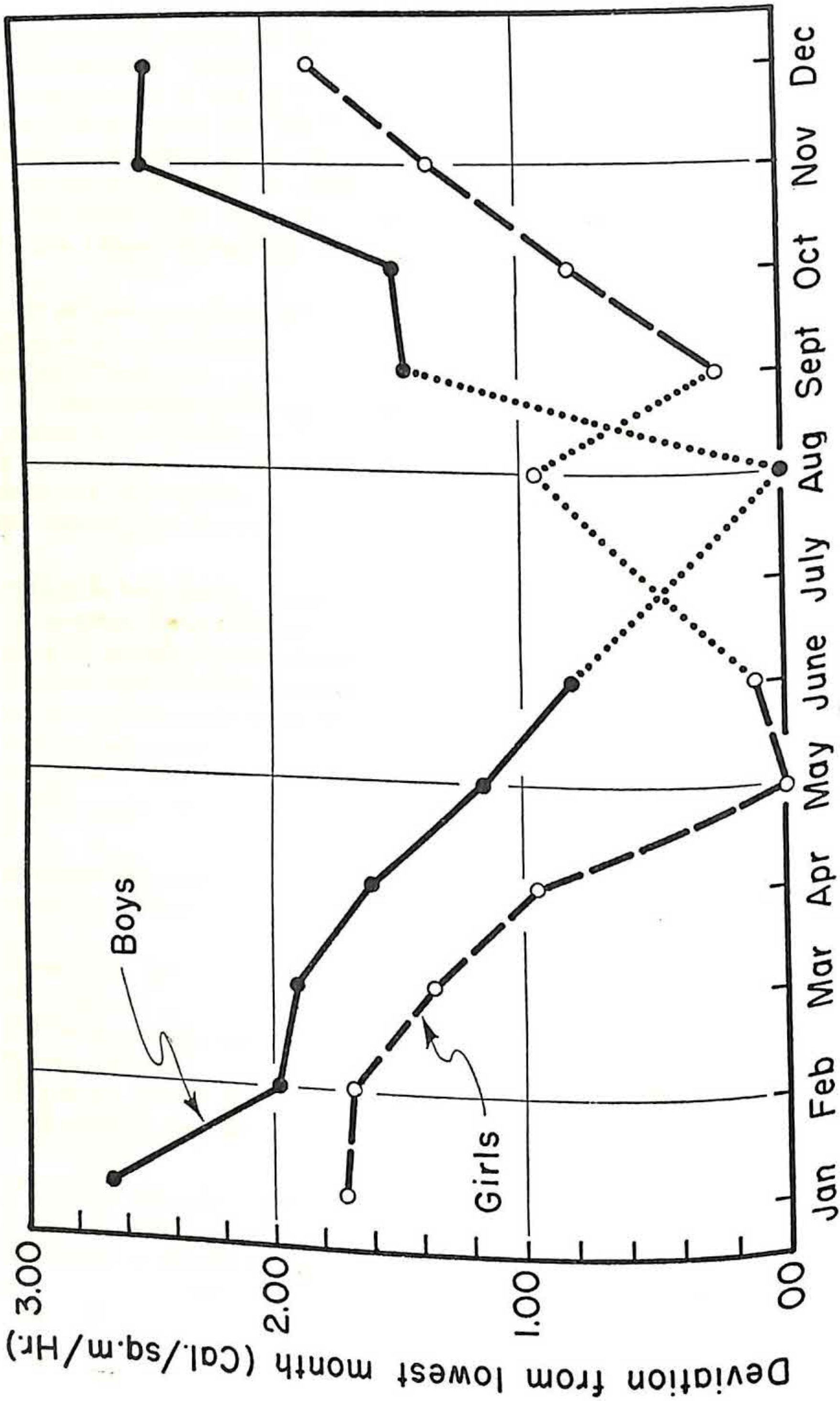
Deviation from lowest month (Cal./sq.m/Hr.)
3.00
2.00
1.00
00
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Boys
Girls

FIGURE 2

TABLE I

MEAN MONTHLY VALUES FOR FIVE PHYSIOLOGICAL MEASURES (CORRECTED FOR AGE AND INDIVIDUAL DIFFERENCES) EXPRESSED AS DEVIATIONS FROM LOWEST MONTH

	Body Temperature (degrees F)		*BMR* (cal/sqm/hr)		*Pulse Rate* (per min)		*Respiratory Rate* (per min)		*Systolic Blood Pressure* (mm merc)	
	N		*N*		*N*		*N*		*N*	
January										
Boys	44	.00	44	2.66	44	1.7	41	.13	44	1.4
Girls	43	.09	44	1.71	44	3.1	43	.71	44	1.3
February										
Boys	48	.15	48	1.98	48	2.3	48	.37	48	.8
Girls	45	.09	44	1.68	44	1.8	43	.00	44	2.0
March										
Boys	54	.16	55	1.90	55	1.6	52	.54	55	1.3
Girls	56	.12	59	1.36	59	1.9	62	.48	59	.9
April										
Boys	51	.24	51	1.60	51	.7	52	.28	51	.0
Girls	56	.14	56	.95	56	1.3	54	.30	56	1.3
May										
Boys	58	.28	59	1.16	59	1.8	53	.36	59	1.1
Girls	44	.15	44	.00	44	1.2	44	.59	44	.9
June										
Boys	14	.25	14	.81	14	.4	13	.63	14	4.2
Girls	10	.19	10	.11	10	.0	10	.30	10	1.9
August										
Boys	6	.19	6	.00	6	.0	6	.03	6	.5
Girls	7	.00	6	.94	6	1.7	6	.88	6	1.9
September										
Boys	62	.20	63	1.45	63	1.6	61	.35	63	.9
Girls	56	.04	57	.24	57	1.7	57	.25	57	.0
October										
Boys	66	.19	70	1.49	70	1.9	66	.36	70	.2
Girls	73	.11	73	.80	73	2.8	72	.30	73	1.0
November										
Boys	67	.17	65	2.50	65	3.0	64	.00	65	2.1
Girls	54	.09	55	1.35	55	3.3	54	.30	55	1.0
December										
Boys	54	.19	51	2.47	51	3.1	51	.69	51	1.2
Girls	38	.05	38	1.82	38	3.3	38	.38	38	1.4

NOTE—No measures were taken in July.

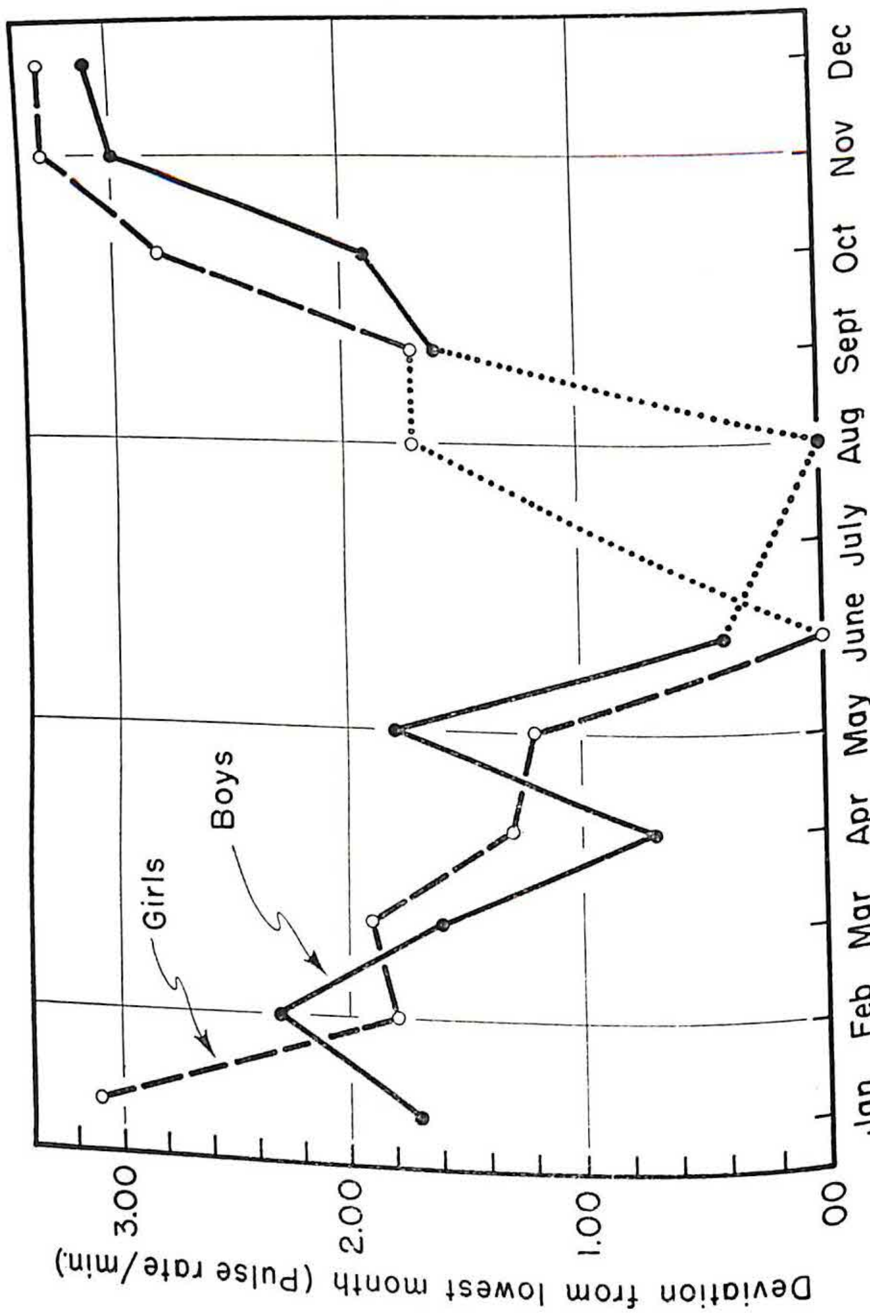
Girls
Boys
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
00
1.00
2.00
3.00
Deviation from lowest month (Pulse rate/min.)

FIGURE 3

cent level. The "*F*" for girls is .86, which is not significant with 10 and 471 degrees of freedom. A very low *eta* of .06 is significant.[4] Except for the June and August points which, unfortunately, are based on very small numbers of cases, there is only one serious departure from the general trend. The September point for the girls is very low. (The January point for boys is so different from both December and February as to be puzzling, but it is not a reversal.)

Figure 2 presents the twice-corrected means for basal metabolic rate. The great consistency of these curves leaves little doubt that there is a true seasonal variation.[5]

The curves in Figure 3 present the results of the analysis of pulse rate. They follow those for BMR rather closely, showing the same decline throughout the spring and the same rise throughout the autumn.[6]

As can be seen from Table 1 there is no indication of seasonal variation in either respiratory rate or systolic blood pressure.

Discussion

The rank order correlation coefficients between average monthly environmental temperature and the average values of the twice-corrected physiological measures are as follows:

	Boys	*Girls*
Temperature × Pulse Rate	—.56	—.67
Temperature × BMR	—.90	—.89
Temperature × Oral Temperature	+.75	+.35

While the number of cases upon which each correlation is based is very small, ten, (the August points were not used since they are based on very few observations) they suggest a straightforward interpretation in terms of seasonal change in environmental temperature. Thus, as environmental temperature increases, the body loses less heat, body temperature rises, and heat production and BMR decrease. The known proportionality between pulse rate and metabolic level (1) is reflected in the striking parallel of these two curves. Such an explanation is consistent with a number of previous studies of variation in body temperature as a function of environmental temperature (1, 11) as well as with investigations (3, 4) which have reported high BMR's in winter and low BMR's in summer. In addition, the explanation in terms of environmental temperature accounts for data from the southern United States which indicate average BMR values of from —6 per cent to —18 per cent (1, 5, 13). Finally, the lesser seasonal variation in temperature and BMR among girls is consistent with the observations of Hardy, Milhorat and DuBois (6) regarding sex differences in adjustment to environmental temperature. We have previously suggested (2) that this sex difference may be partly due to the insulating effect of subcutaneous fat in girls.

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[4] Our statistical procedure is not entirely satisfactory. We have run a straightforward analysis of variance with the twice-corrected measures. We have assumed the total degrees of freedom, to be equal to the total number of (twice-corrected) measures (524 for boys, 482 for girls) minus 1, or 523 for boys and 481 for girls. Ten degrees of freedom are lost to the months, which leaves 513 for the within months variance estimated for boys, and 471 for girls.

[5] Analysis of variance yields an "*F*" of 3.09 for boys and 4.00 for girls. With 10 and 515 degrees of freedom for boys and 10 and 475 for girls, these values are significant at approximately the 0.1 per cent level.

[6] Analysis of variance yields an "*F*" of 1.90 for boys and 2.12 for girls. With 10 and 515 degrees of freedom for boys and 10 and 475 degrees of freedom for girls, these values are significant at the 5 per cent level.

The environmental hypothesis does not account for the absence of seasonal variation in respiratory rate and systolic blood pressure. However, since except at extreme temperatures only 12 per cent of the heat loss in man is due to vaporization from the lungs (1) it may well be that within the rather narrow range of temperature variation in the San Francisco Bay region no significant effects in respiratory rate should have been expected. With regard to blood pressure, if there were changes in peripheral resistance due to vasoconstriction and vasodilation they were not reflected in pressure in a major artery.

While the environmental temperature hypothesis has a number of advantages it does not account for irregularities in the seasonal curves. Among these are the very low point for boys' temperature in January and the low September point for girls' temperature (see Figure 1). If the unreliable June and August points are omitted, the variation in temperature amounts to less than three-tenths of a degree Fahrenheit in boys and approximately one-tenth of a degree in girls. The total variation in BMR is less than two calories per square meter per hour. For pulse rate the total variation is about two beats per minute. These slight changes are probably of little clinical interest. However, if an environmental temperature hypothesis is correct, it is quite possible that in regions where the seasonal changes in climate are greater than in the San Francisco Bay area these changes might become matters of some importance.

The observed seasonal variations might be a function of some other seasonal variable than temperature such as change in amount of sunlight. If this interpretation is correct, then persons living in geographical locations with different climates but similar latitudes, e.g. Great Britain and central Saskatchewan, should show similar seasonal variations in these measures. If the relevant factor is environmental temperature, then greater seasonal variation ought to be found in areas where the seasonal temperature variations are greater, e.g. Saskatchewan.

An alternative interpretation has been suggested by Nylin (12) who found higher BMR's and accelerated growth in stature among Swedish children during the periods from March to May and from November to January. He has advanced a growth rhythm hypothesis to account for the correspondence. Such an hypothesis probably will not account for our data since most investigations in the United States suggest that if there is seasonal variation in statural growth the highest rates occur during the spring and summer when these subjects have decreasing BMR's. Further, Jones (9) has shown that for these subjects the maximum increments in strength also occur during the spring. Finally, both Marshall's summary of American research (10) and the work of Reynolds and Sontag (14) suggest that increments of weight are minimal during the spring and early summer. Clearly, the simple relationship between BMR and indices of growth that is implied by Nylin's hypothesis will not account for all the facts. A paper now in progress will examine the relationship of the variations in the measures reported here with the increments in height and weight of these subjects.

Summary

We have examined BMR, oral body temperature, basal pulse rate, respiratory rate, and systolic blood pressure for evidence of seasonal variation during adolescence. We find fairly clear evidence of a fall in BMR and pulse rate during the spring, followed by a rise during the autumn. Tentative evidence of an opposite effect in body temperature in boys, but not in girls, has been reported.

References

1. DuBois, Eugene F. *Basal metabolism in health and disease.* Philadelphia: Lea and Febiger, 1936.
2. Eichorn, Dorothy H. and McKee, John P. Oral temperature and subcutaneous fat during adolescence. *Child Develpm.* 1953, 24, (this issue).
3. Griffith, Fred R., Jr., Pucher, George W., Brownell, Katherine A., Klein, Jennie D., and Carmer, Mable E. Studies in human physiology. I. Metabolism and body temperature (oral) under basal conditions. *Amer. J. Physiol.,* 1929, 87, 602-632.
4. Hafkesbring, Roberta and Collett, Mary. Day to day variation in basal metabolism of women. *Amer. J. Physiol.,* 1924, 70, 73-85.
5. Hafkesbring, Roberta and Borgstrom, P. Studies of basal metabolism in New Orleans. *Amer. J. Physiol.,* 1926, 79, 221-228.
6. Hardy, J .D., Milhorat, A. T., and DuBois, E. F. Clinical Calorimetry No. 54. Basal metabolism and heat loss of young women at temperatures from 22° C. to 35° C. *J. Nutrit.,* 1941, 21, 383-404.

7. Jones, H. E. The adolescent growth study. *J. consult. Psychol.*, 1939, 3, 157-159; 177-180.

8. Jones, H. E. Seasonal variations in IQ. *J. exp. Educ.*, 1941, 10, 91-98.

9. Jones, H. E. *Motor performance and Growth.* Berkeley: University of California Press, 1949.

10. Marshall, E. L. Review of American research on seasonal variation in stature and body weight. *J. Pediat.*, 1937, 10, 819-831.

11. Martin, Charles J. Thermal adjustments of man and animals to external conditions. *Lancet*, 1930, 219, 217-220.

12. Nylin, Gustav. Periodical variations in growth, standard metabolism, and oxygen capacity of the blood in children. *Acta med. Scandinavica Suppl.*, 1929, 31, 2-207.

13. Remington, Roe E. and Culp, F. Barstow. Basal metabolic rate of medical students and nurses in training at Charleston, S.C. *Arch. Int. Med.*, 1931, 47, 366-375.

14. Reynolds, E. L. and Sontag, L. W. Seasonal variations in weight, height, and appearance of ossification centers. *J. Pediat.*, 1944, 24, 524-535.

15. Reynolds, Earle L. The distribution of subcutaneous fat in childhood and adolescence. *Monog. Soc Res. Child Develpm.*, 1950, 15, No. 2.

16. Shock, Nathan W. and Soley, M. H. Average values for basal respiratory functions in adolescents and adults. *J. Nutrit.*, 1939, 18, 143-153.

17. Shock, Nathan W. Standard values for basal oxygen consumption in adolescents. *Amer. J. Dis. Child.*, 1942, 54, 19-32.

18. Shock, Nathan W. Basal blood pressure and pulse rate in adolescents. *Amer. J. Dis. Child.*, 1944, 68, 16-22.

ORAL TEMPERATURE AND SUBCUTANEOUS FAT DURING ADOLESCENCE

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Oral temperatures and measures of subcutaneous fat for boys and girls of the Adolescent Growth Study of the University of California's Institute of Child Welfare are reported. The relationship of temperature to subcutaneous fat, BMR, and to the menarche is analyzed.

METHOD

All of the data have been obtained from the files of the Adolescent Growth Study[1] (6). Fifty-three boys and fifty-two girls representing a cross section of five elementary school districts in Oakland, California, were tested and measured at approximately six month intervals from 1933 to 1938. The mean age at first testing was 11.87 years. Children were selected for the study on the basis of the willingness of their parents to cooperate in a long term investigation and the probability of permanent residence in the area.

Oral Temperature

Oral temperatures were included in a battery of physiological measures made at the laboratory on two successive days each semester. The subjects were brought from their homes by automobile at 7:30 a.m., before breakfast. After determinations of blood pressure and pulse rate were made, the subject lay on a cot for twenty minutes while oral temperature was taken and three additional measures of pulse rate and blood pressure were made. A Siebe-Gorman half mask was then adjusted, and after a ten-minute respiratory adjustment period, the first of three eight-minute determinations of BMR was begun. A second reading of temperature was taken after the last BMR measure. The temperature determinations were made with a clinical thermometer which was held under the tongue for two minutes. The reading was taken and the thermometer was returned to the mouth for an additional minute to check reliability. The oral temperatures reported here are the average of four readings, i.e., determinations before and after the BMR measures on two successive days.

Subcutaneous Fat

Measures of subcutaneous fat were obtained during the semi-annual physical examination while the subject was sitting on the examining table.

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[1] Harold E. Jones directed the investigation. Nathan W. Shock was in charge of the physiological data collection. The anthropometric program was administered by Herbert W. Stolz.

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The measurements were made with Franzen calipers in three areas: on the anterior surface of the left arm over the biceps; on the abdomen to the left of the umbilicus; and over the crest of the left ilium. Since the calipers measure a fold of tissue the measures, in millimeters, are twice the actual thickness. The values reported here are the sums of these three measures.

TABLE I

MEAN ORAL TEMPERATURE (DEGREES F.) BY AGE IN YEARS

	Girls			Boys		
Age	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*
11.5	22	98.01	.35	25	97.86	.44
12.0	46	97.87	.41	39	97.89	.37
12.5	45	97.84	.33	53	97.95	.37
13.0	52	97.95	.23	43	97.83	.20
13.5	48	97.98	.35	49	97.90	.37
14.0	51	98.00	.40	46	97.73	.46
14.5	48	97.98	.34	51	97.79	.40
15.0	36	98.03	.46	41	97.57	.44
15.5	28	97.96	.27	41	97.59	.48
16.0	29	97.88	.43	32	97.46	.51
16.5	28	97.80	.39	34	97.39	.51
17.0	27	97.79	.43	29	97.44	.47
17.5	13	97.75	.37	16	97.42	.58

RESULTS

Age Trends and Sex Differences in Oral Temperature

Figure 1 shows the mean oral temperature for each sex separately, plotted against age. Smoothed curves are also shown. The smoothed curve for boys was determined by the method of least squares on the assumption of linearity, while that for girls was fitted by eye because linearity could not be assumed.[2] Table 1 gives the empirical values of the means and standard deviations for each sex at each age.

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[2] We know of no fully appropriate statistical method for dealing with these data. As is inevitably the case with longitudinal studies, there is a partial and varying overlap of cases from year to year. Examination indicates that the irregularities in the regression on age are not due to the same few high individuals being measured at some ages and a different few low individuals being measured at others. If one were to assume independence of the individual determinations, *eta* (for girls) would be .35 and significantly different from r (—.10). While such a procedure is not exact we feel curvilinearity the best assumption to make.

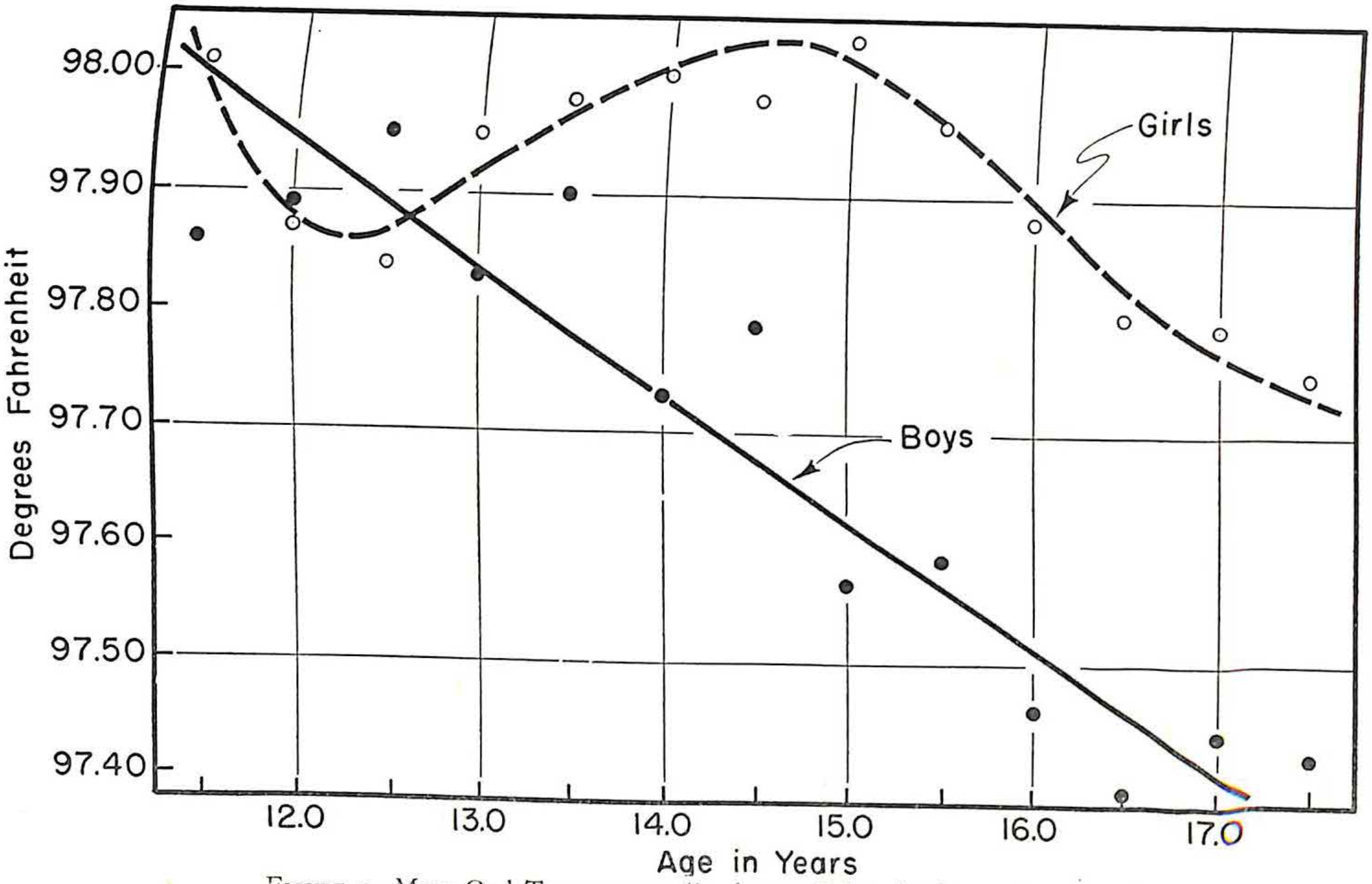

Figure 1—Mean Oral Temperature (in degrees Fahrenheit) as a function of age.

It will be noted that every mean is below 98.6 degrees Fahrenheit, a commonly accepted normal oral temperature. It is of interest that several investigators (1, 5, 7) have found the oral temperature of normal subjects under ordinary conditions of daily living to average considerably less than 98.6° F. Further, it is well established (2) that body temperature is at a minimum in the early morning. Iliff and Lee (4) have recently reported this phenomenon in adolescents observed under conditions similar to ours. In addition, our means probably reflect the basal conditions under which the subjects were measured and the fact that values for various physiological measures among trained subjects are usually lower than those for untrained subjects (2). This interpretation agrees with Shock's (11) finding that the BMR's for these subjects are lower than previously reported norms.

A second matter of interest is the systematic decline of oral temperature with increasing age. This trend is particularly marked in the case of boys. Between 12½ and 17½ there is a drop of approximately half a degree Fahrenheit. Our data thus confirm a similar trend recently reported by Iliff and Lee (4) and are consistent with a decline in oral temperature said to occur over an even longer age span (10).

The girls' age trend apparently differs from the boys'. The boys' curve approximates linearity, whereas the girls' is more complex. For girls, an early decline appears to be followed by a two and a half year rise and then

TABLE 2

MEAN SUBCUTANEOUS FAT OF GIRLS BY AGE IN YEARS

	Physiological Group			Non-Physiological Group			Total		
Age	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*
10.5	10	76.4	17.4	8	65.8	11.0	18	71.7	15.8
11.0	26	74.6	20.8	19	75.3	16.4	45	74.9	19.1
11.5	32	77.7	20.4	24	82.6	16.8	56	79.8	19.1
12.0	39	82.6	23.8	33	79.6	14.8	72	81.3	20.2
12.5	45	81.3	22.4	34	81.6	15.6	79	81.4	19.8
13.0	45	84.8	24.5	39	85.1	16.9	84	85.0	21.3
13.5	46	89.0	21.6	37	88.5	22.0	83	88.8	21.8
14.0	47	88.4	21.7	35	86.3	19.6	82	87.5	20.9
14.5	44	92.0	20.2	37	87.4	15.6	81	89.9	18.4
15.0	39	92.2	22.8	36	88.7	16.9	75	90.5	20.3
15.5	38	93.3	19.0	34	89.2	14.5	72	91.3	17.2
16.0	26	93.5	21.9	17	90.5	18.4	43	92.3	20.6
16.5	7	88.9	43.3	11	96.6	20.7	18	93.6	31.7

NOTE—Tables 2 and 3 give comparable data for a control group for whom no physiological measures were gathered.

TABLE 3

MEAN SUBCUTANEOUS FAT OF BOYS BY AGE IN YEARS

	Physiological Group			Non-Physiological Group			Total		
Age	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*	*N*	*M*	*S.D.*
10.5	17	44.4	9.4	13	47.5	11.9	30	45.7	10.7
11.0	37	44.4	11.2	25	46.5	10.5	62	45.2	11.0
11.5	47	46.5	12.9	34	47.7	10.2	81	47.0	11.8
12.0	48	48.7	12.8	40	47.2	10.7	88	48.0	12.0
12.5	48	48.8	11.3	41	47.5	7.8	89	48.2	9.9
13.0	50	48.7	12.4	42	46.8	7.6	92	47.8	10.4
13.5	51	48.0	11.8	41	46.0	7.0	92	47.1	10.0
14.0	49	47.4	11.5	40	44.6	5.8	89	46.1	9.6
14.5	49	46.1	9.8	37	43.5	5.1	86	45.0	8.2
15.0	49	46.1	9.7	37	43.7	5.1	86	45.0	8.5
15.5	46	44.8	9.6	31	43.0	4.0	77	44.0	7.8
16.0	39	44.6	10.0	33	42.4	5.6	72	43.6	8.4
16.5	46	45.6	9.0	33	43.4	7.1	79	44.7	8.3
17.0	46	45.1	8.5	32	45.3	7.3	78	45.2	8.0
17.5	37	47.5	10.2	24	46.3	5.6	61	47.0	8.7
18.0	24	48.0	10.2	13	47.5	6.1	37	47.9	9.0

a second decline from age 15½ onward. Although Iliff and Lee (4) did not find such a reversal, the regression in our data apparently is curvilinear.[2]

An additional fact appearing in Figure 1 is the consistently higher oral temperatures of girls as compared with boys. While the consistency is limited by the fact that the samples at various ages are not independent, the fact remains that the mean difference of .23 degrees is significant[3] at well beyond the 1 per cent level. Further, this difference appears at the same age, 13, as it did among the Iliff and Lee subjects and, as in their subjects, is maintained thereafter.

Age Trends and Sex Differences in Subcutaneous Fat

In their investigations of temperature regulation Hardy, Milhorat and DuBois (3) and DuBois (2) have demonstrated that women are better insulated by skin and subcutaneous tissue than men. It seemed possible to us that this sex difference in insulating tissue might help to account for the higher temperatures found in girls. Further, the reversal in the downward age trend for temperature in girls may be due to girls' tendency to add large increments of insulating fatty tissue during adolescence.

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[3] "*t*," computed by determining the mean temperature for each child and then finding the overall mean sex difference, equals 3.2 with 103 degrees of freedom. The separate "*t*'s" for sex differences are not significant until age 13, where the difference is significant at the 5 per cent level. From age 14-17 the differences are significant at or beyond the 1 per cent level.

In order to test the hypothesis that body temperature is related to amount of subcutaneous tissue, we first computed the sums of the three measures of fat for each individual for each age. These normative data will be presented first. Tables 2 and 3 give the means and standard deviations of the distributions for each sex at each age. The measures for girls are curtailed at the older ages because the measures at these ages were made by a different examiner. Although this examiner's measures were reliable within themselves, they differed significantly from those of the previous examiner and have been omitted.

The age trends and sex differences are remarkably similar to those found by Reynolds (8), who used a much more exact technique of measurement. The girls show increasing amounts of subcutaneous fat up to age 16. Unfortunately, we are unable to report on later ages among girls due to the change in examiners. The boys' trend is curvilinear, rising to age 12, declining from 13 to 16 or 17, and rising thereafter. This trend also parallels

TABLE 4

CORRELATIONS AT SUCCESSIVE AGES BETWEEN TEMPERATURE AND FAT

	Girls				Boys	
	Examiner I		Examiner II			
Age (years)	*N*	*r*	*N*	*r*	*N*	*r*
11.5	12	+.04			13	+.32
12.0	27	+.02			37	−.04
12.5	38	−.17			40	−.03
13.0	37	+.18			46	+.50**
13.5	37	+.11			44	+.17
14.0	43	+.17			45	+.17
14.5	38	+.06			46	−.01
15.0	31	−.07			40	+.05
15.5	22	+.10			34	+.15
16.0	11	−.04	9	+.49	31	+.60**
16.5			18	+.26	33	−.02
17.0			25	+.41*	30	+.27
17.5			14	+.20	17	+.04

Note—Because of the change in examiners noted previously, there are two series of correlations for girls at the older ages.

* $P < .05$.

** $P < .01$.

TABLE 5

DISTRIBUTIONS OF "WITHIN-INDIVIDUALS" CORRELATIONS BETWEEN TEMPERATURE AND FAT

r	*Girls*	*Boys*
+.9	1	1
+.8	1	0
+.7	0	1
+.6	1	1
+.5	6	4
+.4	3	4
+.3	6	3
+.2	2	4
+.1	7	4
+.0	4	5
—.0	3	5
—.1	3	4
—.2	0	2
—.3	4	4
—.4	3	3
—.5	3	1
—.6	1	3
—.7	3	3
—.8	1	0
—.9	0	0
N	52	52
N+	31	27
N—	21	25
Mdn.	+.1	+.0
P	<.20	....

and confirms Reynolds' trend at the older ages where he had few subjects. The girls consistently show greater amounts of subcutaneous fat than do the boys, and this difference increases until at least age 16. Although in our group the size of the difference is a function of the fact that different examiners were used for each sex, the general difference between sexes is too well established to be questioned.

Relationship Between Oral Temperature and Subcutaneous Fat

If the hypothesis that differences in body temperature are at least partially due to differences in insulating subcutaneous tissue is correct, then one might reasonably expect parallels between these two measures. Three possible approaches suggest themselves: comparison of the age trends, correlation coefficients computed at each age, and correlations within each individual over time.

Comparison of Table 1 with Tables 2 and 3 indicates no parallel in the age trends for either boys or girls. The correlations at each half-year age interval are listed in Table 4. While there is a predominance of positive correlations, no clear-cut trend is apparent and only three of the coefficients are statistically significant (age 17 for girls and ages 13 and 16 for boys). The distributions of the correlations for each individual are given in Table 5. For boys, the median correlation is essentially zero. For girls, the median correlation is very low but positive.[4] In brief, neither the correlations within individuals nor the correlations at different ages lend strong support to the hypothesis that the reversal in the downward trend of girls' temperature is due to the insulating effect of fatty tissue. At best the evidence is only suggestive.

TABLE 6

CORRELATIONS AT SUCCESSIVE AGES BETWEEN BMR AND TEMPERATURE

	Girls		*Boys*	
Age (years)	*N*	*r*	*N*	*r*
11.5	14	+.37	16	+.12
12.0	29	+.43•	37	+.37•
12.5	43	+.25	44	+.54••
13.0	39	+.06	45	+.01
13.5	44	+.09	45	+.06
14.0	45	+.28	45	+.09
14.5	41	+.17	47	—.03
15.0	34	+.20	41	+.08
15.5	31	+.18	35	+.36•
16.0	23	+.49•	34	—.01
16.5	25	+.28	33	+.00
17.0	28	+.05	30	+.17
17.5	19	+.21	23	+.22

• $P < .05$.

•• $P < .01$.

Relationship Between Oral Temperature and BMR

Although Shock's BMR norms for these girls (12) show no reversal corresponding to the one found in temperature, some of the individual curves (12) do suggest such a phenomenon. Therefore, the correlations between oral temperature and BMR at different ages, and correlations between oral temperature and BMR for each subject individually were computed. The correlations at each age are given in Table 6. For girls, all the coefficients are positive, although only two of them, age 12 and age 16,

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[4] The probability of obtaining 59 per cent positive correlations by chance is .10 (one-tailed test).

TABLE 7

DISTRIBUTIONS OF "WITHIN-INDIVIDUALS" CORRELATIONS BETWEEN TEMPERATURE AND BMR

r	*Girls*	*Boys*
+.9	1	1
+.8	0	1
+.7	2	3
+.6	3	5
+.5	1	3
+.4	3	4
+.3	6	4
+.2	1	9
+.1	4	4
+.0	4	2
—.0	9	9
—.1	1	1
—.2	6	1
—.3	1	3
—.4	3	0
—.5	3	0
—.6	3	1
—.7	0	1
—.8	1	0
—.9	0	0
N	52	52
N+	25	36
N—	27	16
Mdn.	—.0	+.2
P	....	<.01

reach significance at the 5 per cent level, using a two-tailed test. For boys, eleven of the thirteen are positive and three (12, 12.5, and 15.5) are significant.

The distributions of individual correlation coefficients between temperature and BMR are given in Table 7. For girls the median value is zero, while for boys it is low, but positive.[5] Thus the positive evidence provided by the correlations at separate ages is not confirmed for girls, but it is confirmed for boys.

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[5] The probability of obtaining 69 per cent positive correlations by chance is less than .01.

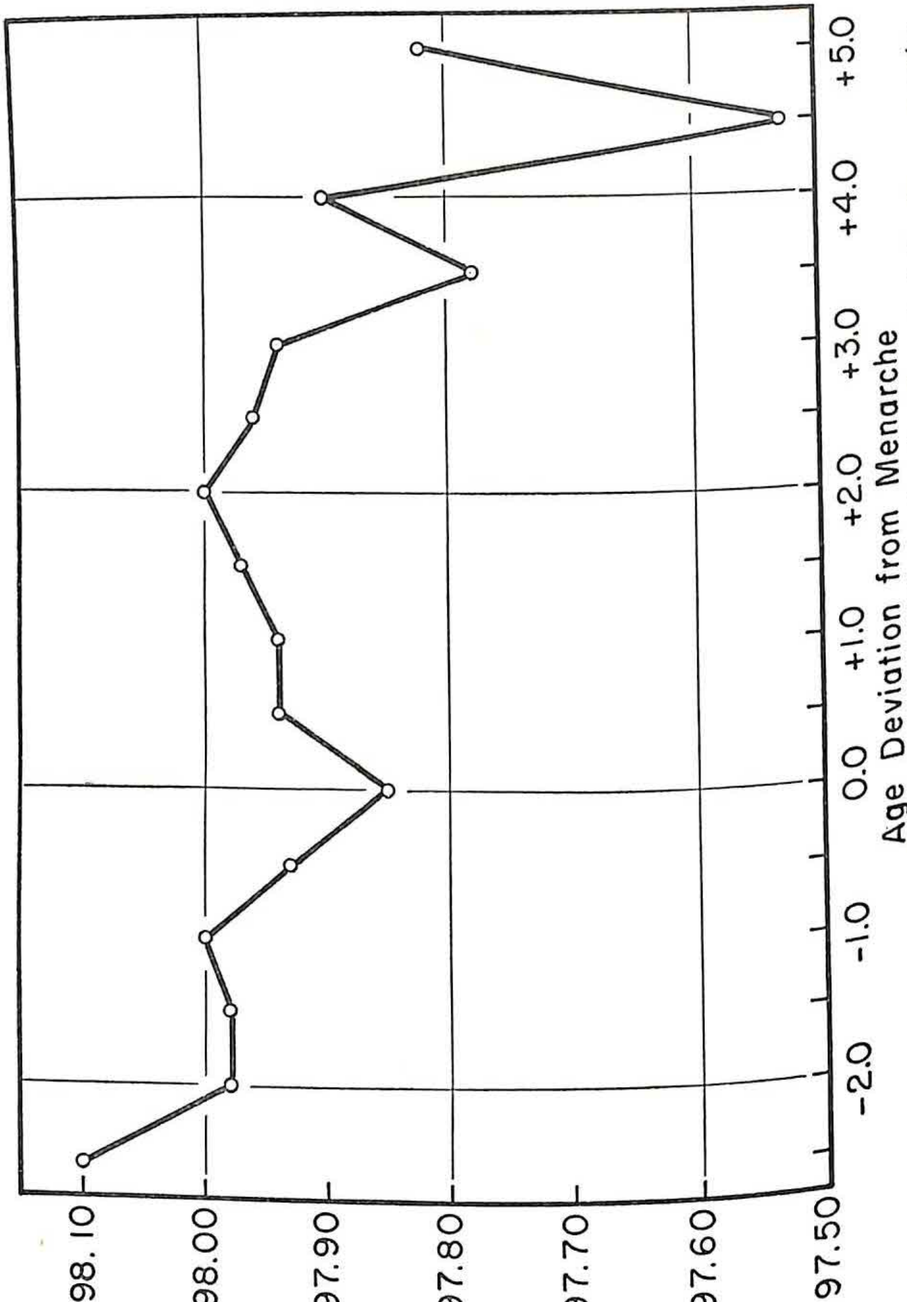

FIGURE 2—Mean Oral Temperature (in degrees Fahrenheit) as a function of age deviation from menarche.

Relationship Between Oral Temperature and the Menarche

Shock (12) has shown that for several aspects of physiological development age deviation from menarche is a more meaningful index of developmental status than is chronological age. Since body temperature is known to be related to the menstrual cycle (9) and since the reversal in the downward trend of body temperature takes place during the age range when most of these subjects reached the menarche the data were retabulated in terms of age deviation from menarche. Figure 2 shows the temperature means plotted against age deviation from menarche (ADM). The reversal in downward trend of oral temperature does occur at the menarche; thereafter the trend is upward for two years. Table 8 lists the means and standard deviations.

TABLE 8

MEAN ORAL TEMPERATURE BY AGE DEVIATION FROM MENARCHE

ADM (years)	*N*	*M* (° F.)	*S.D.*
—2.5	10	98.10	.21
—2.0	10	97.98	.27
—1.5	16	97.98	.30
—1.0	27	98.02	.27
—0.5	39	97.93	.35
0.0	41	97.85	.37
+0.5	43	97.94	.33
+1.0	43	97.94	.37
+1.5	41	97.97	.49
+2.0	39	98.00	.42
+2.5	36	97.96	.39
+3.0	25	97.94	.35
+3.5	24	97.78	.46
+4.0	16	97.90	.40
+4.5	13	97.53	.38
+5.0	8	97.82	.40

DISCUSSION

The decline in temperature for both boys and girls and the higher temperature of girls are supported by data from other investigations. However, interpretation of these findings is somewhat difficult.

We examined the relationship between oral temperature and several other variables which seemed likely to be pertinent. It seemed possible that the sex difference in oral temperature might be due to sex differences in insulating fatty tissue, but no parallel was found in the age trends in these two variables. Correlational techniques yielded slight indications of a positive relationship between these two variables in girls, but not in boys. Possibly the amount of subcutaneous tissue is too small in boys to have a measurable effect, but this is only conjecture.

In the case of the relationship between temperature and BMR the positive evidence is largely restricted to boys. For boys, the age curves for oral temperature and BMR are roughly parallel and both the individual correlations and the correlations at different ages tend to be positive. For girls, however, the temperature age trend exhibits a reversal which is not found in the BMR data and although the correlations at different ages are positive, the individual correlations center around zero.

Finally, we examined the possibility that the menarche is a complicating factor in the age trend in girls' temperature. Oral temperature plotted in terms of ADM does indicate a possible relationship. The early decline ends at the menarche. However, this gives us no explanation for the following rise and fall.

None of the relationships between temperature and other variables are sufficiently clear-cut to convince. No single variable studied will account for age trends in both sexes, for sex differences, and for the reversal in age trend among girls. It may be that temperature levels in girls are more influenced by subcutaneous fat and subject to variation with the menstrual cycle, whereas in boys, in whom the amount of subcutaneous tissue is comparatively small and changes less with age, BMR is a more important factor. However, the extent of these relationships is so slight that an entirely different hypothesis may be required.

SUMMARY

Age trends and sex differences in oral temperature and subcutaneous fat among 53 boys and 52 girls measured from approximately age 11 to age 18 were examined.

Oral temperatures declined during this age period in both sexes, the decline being more marked, and approximately linear in boys. Among girls the decline was reversed between the ages of 13.0 and 15.5. After age 13, the girls' oral temperatures were significantly higher than the boys'.

No relationship between oral temperature and subcutaneous fat was observed in boys. Indications of a positive relationship were obtained in girls. Little relationship between oral temperature and BMR was observed in girls. Indications of a positive relationship were obtained in boys.

When oral temperature was considered in relation to the menarche, it was found that the early decline in temperature reversed itself at the menarche, rising for about two years thereafter before resuming the decline.

Subcutaneous fat in girls increased until the age of 16. Among boys, subcutaneous fat showed comparatively little systematic variation with age. The trend was curvilinear, increasing to age 12, declining somewhat from 13 to about 17, and then increasing again to 18.

References

1. Benedict, F. G. and Carpenter, T. M. *The metabolism and energy transformation of healthy man during rest.* Carnegie Institute of Washington Pub., No. 126, 1910.
2. DuBois, Eugene F. *Fever and the regulation of body temperature.* Springfield, Illinois: Charles C. Thomas, 1948.
3. Hardy, J. D., Milhorat, A. T., and DuBois, E. F. Clinical Calorimetry No. 54. Basal metabolism and heat loss of young women at temperatures from 22° C. to 35° C. *J. Nutrit.,* 1941, 21, 383-404.
4. Iliff, Alberta and Lee, Virginia A. Pulse rate, respiratory rate and body temperature of children between two months and eighteen years of age. *Child Develpm.,* 1952, 23, 237-246.
5. Ivy, A. C. What is normal or normality. *Quart. Bull. Northwestern Univ. Med. School,* 1944, 18, 22.
6. Jones, H. E. The adolescent growth study. *J. of consult. Psychol.,* 1939, 3, 157-159; 177-180.
7. Paton, J. H. P. The mean temperature of healthy girls. *Brit. med. J.,* 1932, 2, 142-143.
8. Reynolds, Earle L. The distribution of subcutaneous fat in childhood and adolescence. *Monog. Soc. Res. Child Develpm.,* 1950, 15, No. 2.
9. Rubenstein, Boris B. The constancy of basal metabolism and pulse rate in relation to body temperature and the menstrual cycle. *Amer. J. Physiol.* (Proc.), 1937, 119, 393-394.
10. *Starling's principles of human physiology.* C. L. Evans, (Ed.). Philadelphia: Lea and Febiger, 1941.
11. Shock, N. W. Standard values for basal oxygen consumption in adolescents. *Amer. J. Dis. of Child.,* 1944, 68, 16-22.
12. Shock, N. W. Physiological changes in adolescence. (In) *Forty-third Yearbook of the National Society for the Study of Education,* Part I. Chicago: Dept. Educ., Univ. Chicago, 1944.

WHY AN INTERDISCIPLINARY SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT[1]

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Two years ago its president, Dr. L. W. Sontag, addressed this Society, tracing its evolution and questioning how to re-invigorate the group. His over-view clearly reflects the social change which is of major concern to us—the decreasing attention given to child development as a common focus of several disciplines.

Child psychologists are also currently concerned with the apparent lack of vigor in their field. At one time many psychologists thought that the description of the growth process would give them something unique, which a study of behavior modifications in rats or adult men could not give. They looked to comparative, experimental embryology and to patterns of human growth to provide the principles or concepts about which they could organize their thinking concerning behavior change. A striking feature of current child psychology literature is the absence of discussions of growth or of the use of growth concepts in an attempt to organize thinking about child behavior. In current psychological discussion there is little awareness of research on hormones or of modifications of diet, as these factors may relate to behavior.

Here has been the traditional contribution of the Society for Research in Child Development. Under the auspices of this organization, bodies of research material based on physiological processes have been brought to the attention of psychologists and educators, sociologists and nursery school teachers, and *vice versa,* the concern with the child as a learning organism in a social world has been brought to the attention of biologists and anatomists, orthodontists, and biochemists. Despite expressions of dissatisfaction with our efforts, of lack of common language or integrated theory, this has not been an insignificant achievement. There are many demonstrations for example, that the child psychologist who has been active in the Society for Research in Child Development is aware, as other child psychologists are not, of literature in related areas, and of concepts in other disciplines which have fruitful impact on his own thinking. More often than not, such a psychologist has a broader view of the child as a growing, changing organism and especially of the significance of research findings for practical

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matters of child nurture and guidance than his colleague of somewhat more restricted training.

The interdisciplinary idea is not dead. Since 1946 there has arisen in practically every major university a center or laboratory for research in human relations, or social behavior, or social relations. One and all, these are interdisciplinary efforts in the broad field of social science. Everyone agrees that in an age of rapidly multiplying data and overlapping areas of concern, we ought to achieve more integration, more concerted attack on common problems.

Perhaps we now lack the sense of mission which gripped our field in its earlier days; perhaps we are not so sure that through facilitating child growth we can attain the "Good Society." Our currently popular interdisciplinary efforts appear to be searching for principles of group life—social, economic, political—which when properly manipulated and applied will attain at least a better Society. Studies of child behavior in the group, under this new approach search also for these general principles. There is less concern with childhood for its own sake, on the assumption that a good childhood insures good adult living.

Dr. Sontag pointed out that lack of venerable academic tradition has handicapped us. An expert is truly expert in only a limited area, and often he gets his greatest professional recognition and satisfaction in an "old line" department. This problem has troubled the various child development institutes, and some of the newer centers for interdisciplinary effort in the social sciences report growing awareness of this same problem. They too, may repeat our developmental cycle, find themselves lacking a first row chair at the academic council tables, fail to preserve their sense of mission, and may in time hold similar progress and planning sessions such as this one. I predict that others are and will be grappling with the sense of helplessness which seems to come with broad gauge interdisciplinary effort.

Several major attacks have been made on the serious problem of establishing among several disciplines a common floor on which to work. An approach which is currently being argued in psychology for the behavior sciences and which has many proponents, is the attempt to establish a hypothetico-deductive system with theorems and postulates marshalled in proper logical order, from which hypotheses can be stated which may be subjected to experimental test, in the usual logic of science. A number of such efforts toward unifying theory have taken place recently in the area of social relations, or social behavior. Participants in these efforts have sooner or later come to realize the tremendous difficulties involved in semantics, private meanings, and the perennial problem of perception which is contaminated by the preconceptions of the observer. Nor does a reorganization of terminology wipe out the impact of these private meanings and preconceptions, as much recent psychological research has shown. It has been argued that since these preconceptions inevitably condition the gathering of data it becomes essential that the theory be worked out in the greatest detail before hypotheses are formulated. Professional literature is full of studies which have been subjected to the Procrustean bed of theoretical terminology and made to demonstrate the adequacy of new theory.

Others still urge the familiar approach of empiricism—that we come together at the point of methodology, of operations concerned with data gathering. While it may well be that further multiplication of empirical fact is indeed "beating a dead horse," it can scarcely be denied that in the operations the scientist goes through in defining and measuring his variables there can be somewhat greater agreement than in the development of new systems of abstract terms in an effort to get rid of the freight of old meanings.

A third approach has been the attempt to concentrate on the whole child. Most of us are agreed that one cannot really attend to the whole child—he evades you. We need a process of analysis followed by one of synthesis. The initial broad, broad look never turns up much of significance. One has to focus, and focus again, here and there, and then stand back to observe the areas which he has studied in pin-point detail against the larger body of phenomena which the broader look reveals. We no longer pay much attention to the earlier literature on the "whole child." We recognize that one cannot attain scientific excellence as an expert on the whole child. Indeed, excellence in one's own field, as we remarked earlier, may become something of a deterrent to interdisciplinary effort. The competent person doesn't want to be bothered doing things he cannot do well. This, however, is no argument against the activities of the Society for Research in Child Development. A very competent person coming to another area new to him, even though an amateur, can usually (*a*) raise good questions, (*b*) see "simple-minded" relationships, (*c*) appreciate honesty, scientific caution, and methodological exactness, and (*d*) share in a cooperative spirit of interest arising out of curiosity and the spirit of inquiry which is so characteristic of good science. To provide such opportunities seems to me to be a continuing service of the Society for Research in Child Development.

What suggestions can we make? Two years ago Dr. Sontag believed that we should go to other professional societies, taking our work and interests to their sessions. We have not yet had sufficient time to undertake and to evaluate this procedure. If it should result in only the members of that society attending the joint meeting, we would not of course attain our goal. Perhaps there are undertakings which we as a Society could sponsor which would occur outside of meetings. Perhaps committees of our own membership could undertake to publish within our own journals systematic, scholarly cross-disciplinary reviews of research findings. We continue to need searching surveys of the literature, by area or topic, in an attempt to bring together what we know, critically evaluate it, and indicate the gaps in knowledge. I refer to the type of review which appears in Carmichael's

Manual of Child Psychology (2) and an occasional example of which has appeared in our own Monograph series. These would be scholarly works for scholars.

As is so often the case for sciences which deal with human welfare, our chief consumers consist of the applied folk—educators, teachers, home economics people, pediatricians, parents. These people do not do research themselves, and are not always able to read with understanding our technical documents. But they are eager to improve understandings which grow out of these technical documents and to apply the practical outcomes of research. They will expect useful materials, whether from bodies of empirical norms, or from confirmed or rejected hypotheses which permit greater control of the kinds of behavior they seek to promote.

Some of us ought occasionally to write interpretive articles, or articles which point out the implications as we see them of bodies of research material. These articles should, of course, be published where they will be available to the consumer. If we do not find this to our liking, perhaps we can encourage some of our students to undertake this task, but it is a useful learning experience to force oneself to raise the question "so what?" about some of his work. I say this with full cognizance of the importance of basic research, which attempts to solve no practical problem but merely to advance our understanding of fundamental principles of life processes. We are well aware of what a strictly utilitarian point of view does to science, but it is a chastening and perhaps useful experience to examine periodically one's own work and that of his colleagues with the question, "What does this add up to for human living?"

It may well be that such pulling together of data will force recalcitrant empiricists to reconsider the advantage of theory. On the other hand, such evaluative reviews may have a salutary effect on theory. A case in point is the present situation with respect to research on social behavior of children. Social class theorists and sociometricians are doing a great deal of work on the formation of groups, and the impact of groups on personality process with resulting development of social behaviors. Many of the conclusions emerging from such research, appearing as tests of hypotheses deduced from theory, are available in an earlier descriptive literature. Thorough acquaintance with this earlier literature might well save modern experimenters some time and perhaps much money.

Finally, I would suggest an attempt to develop occasional seminars which would introduce descriptive, systematic reviews of research from one area of study to people in other fields who have a concern with children. Social workers are currently most enthusiastic over an attempt by Otto Pollak and collaborators (6) to examine social science in relation to psychotherapy for children. This book seeks to explore and define the contributions of the behavior sciences to practice in a psychoanalytically oriented child guidance clinic. This project is in itself a case study of a staff seminar in one institution and has been described as a major and outstanding success as a bridge of interdisciplinary gaps. The book is written strictly from the sociological and psychiatric point of view, with one chapter on psychological learning theory. It intentionally avoids the child development literature. The argument advanced for this neglect is that the scientific and quantitative character of the child development literature is discouraging to qualitatively trained social workers who are far more comfortable using descriptive and qualitative language. It is to be regretted that the selection of relevant behavior sciences and their insights was made principally in terms of "comfortable language." Some of us have not had the experience which Dr. Pollak describes. On the contrary, we have found that social workers, given insight into the power of predictive tools and quantitative methods, can become most enthusiastic about them. Pollak's book, it seems to me, is one of the best arguments for broad interdisciplinary seminars which would strive to teach the members of a profession some of the useful tools and concepts developed in another area.

These suggestions are mostly pleas for organizing, for synthesizing. Like many, I am impressed by the extent of our data, and the need to systematize it. Certainly many studies appear pointless; they have been "ground out," simply because it was possible to go through the motions of grinding. Yet, I am not ready to throw out the straight descriptive method. I would like to see some researchers continue to work with molar behaviors, with growth studies, with physiological studies. Perhaps as some hold today, the socially useful concepts *are* independent of a developmental process in which age change is a fundamental dimension. Yet social-psychological theories today are cast in the language of behavior modification. The child development point of view is usually concerned with this modification over a longer period of time than is recognized in many behavior studies.

I am not yet ready to throw out growth as an integrating concept in the child field together with the longitudinal method of studying process. Students of animal behavior who come from biology have long emphasized the need to observe the entire life development of species under a great variety of "natural habitats" before developing hypotheses which can be taken into the laboratory for crucial test. It is interesting to note that, in an attempt to describe the developmental process in mammals other than man, Scott and his co-workers (7) in the field of comparative psychology are now utilizing methods which were applied to children in an earlier period. In the field of child behavior we see Roger Barker (1) applying to children the methods and concepts of naturalistic observation and of ecology which have been so notably advanced by students of animal behavior such as Lorenz (4) and Tinbergen (8). Their hypotheses grow out of an intimate acquaintance with the varieties of behavior manifested by a species. Certainly the cultural anthropologist has represented this point of view, and Margaret Mead (5) goes so far as to argue for the substitution of years of experience for scientific rigor—the experimentalist becoming his own instrument. Few of us would go quite this far, though some of us are a little baffled when we attempt to encompass the behavior of children as we know it within the neat and limited paradigms of the hypothetico-deductive system.

One difficulty revealed by the literature of modern psychological learning theory is the apparent lack of recognition of the complexity and of the reiterative, cumulative character of environment as far as children are concerned. The learning conditions set up by the experimentalist do not come anywhere near approximating the kinds of learning situations which children get themselves into every day. As many have pointed out, there is a tremendous amount of over-learning in many aspects of child's behavior which is never equalled in the laboratory, with human subjects at least. Animal ecologists recognize that cage born and bred animals may learn differently than do animals subjected to the variety of environing conditions found in the "natural" habitat.

Recently, Professor Harlow at Wisconsin has questioned the drive-reduction basis of learning, at least in primates (3). He points to the manipulative, investigative tendency characteristic of monkeys, and to an even greater extent of children. Nor does he seem to be willing simply to call this tendency another "drive." To encompass some of the behaviors observed in children as well as the thirst-hunger-sex drives investigated in rats, one must broaden and generalize the "need" concept so much as to be almost self-defeating. Harlow has also argued for "learning-sets"—that higher organisms, at any rate, "learn how to learn." If this is true, the learning performance is different at different stages of development, and principles established on a very simple organism might not apply to the learning of the same organism at a more complex phase of its development. To use such principles successfully at different levels of complexity one would have to generalize them so broadly that they could mean almost anything. In our earlier history this happened to concepts of "differentiation" and "integration." It may well happen to concepts of "need reduction," "primary and secondary generalization," "latent learning" and the like.

These are reasons why we should occasionally look beyond our own "systems" and regard the organism as broadly as possible as a possible cure for intellectual provincialism. We may not take the time to read each other's journals, but the round tables of an interdisciplinary society may well enlarge our intellectual life-space.

Let us have an extension of behavior theory and the vigorous prosecution of research along its lines. But let some continue, as does the students of comparative behavior, extensive, rigorous observation before taking hypotheses to the laboratory for test. I do not look for the early creation of an interdisciplinary "theory" of child development, applicable with equal facility by all the scientific interests represented here. I am sure that "theory-conscious" thinkers in various areas can learn from observing the methods and operations of their colleagues in related fields. As a result of this wider awareness, the traditional emphasis of our Society, I believe that any scientific investigator will produce results which will more quickly have results for the common good.

REFERENCES

1. BARKER, ROGER G. and WRIGHT, HERBERT F. Psychological ecology and the problem of psychosocial development. *Child Develpm.*, 1949, 20, 131-143.
2. CARMICHAEL, LEONARD (Ed.). *Manual of Child Psychology.* New York: Wiley, 1946.
3. HARLOW, HARRY F. Motivation as a factor in the acquisition of new responses. (In) *Current theory and research in motivation.* Lincoln: Univ. Nebraska Press, 1953.
4. LORENZ, K. Z. The comparative method in studying innate behavior patterns. (In) *Symposia of the Society for Experimental Biology, No. IV, Physiological mechanisms in animal behavior.* New York: Academic Press, 1950.
5. MEAD, MARGARET. "National Character." (In) *Anthropology today, International symposium on anthropology.* A. L. Kroeber, (Ed.) Chicago: University of Chicago Press, 1953.
6. POLLAK, OTTO, et al. *Social science and psychotherapy for children.* New York: Russell Sage Foundation, 1952.
7. SCOTT, J. P. and MARSTON, MARY-'VESTA. Critical periods affecting the development of normal and mal-adjustive social behavior of puppies. *J. genet. Psychol.*, 1950, 77, 25-60.
8. TINBERGEN, N. *The study of instinct.* London: Oxford University Press, 1951.

THE WISC AND THE SRA PRIMARY MENTAL ABILITIES TEST [1]

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This study gives some comparative information concerning two of the newer tests in the field of intelligence measurement, the Wechsler Intelligence Scale for Children (WISC) and the SRA Primary Mental Abilities Test (Elementary) for ages 7 to 11 (SRA).

Although both tests yield an IQ, they differ in many ways. Some of the essential differences are as follows: (2, 3)

1. The WISC is an individual test, while the SRA is intended for group administration.

2. The WISC consists of 12 subtests, 2 of which are considered as supplementary; these two supplementary tests were not used in this study. *Verbal* tests include general information, comprehension, arithmetic, similarities, and vocabulary. *Performance* tests are picture completion, picture arrangement, block design, object assembly, and digit-symbol.

The SRA consists of 5 subtests, each of which is designed to measure a separate "primary mental ability" — Verbal-meaning, Space, Reasoning, Number, and Perception.

3. The WISC yields a Total IQ, Verbal IQ, and Performance IQ. The SRA yields a total IQ, plus an IQ for each of the primary mental abilities tested.

4. WISC IQ's are obtained by comparing each subject's performance with scores earned by individuals in his own age group. SRA scores are obtained by comparing each subject's performance with scores earned by individuals in a composite age group.

The two general questions with which this study is concerned are:

1. To what degree and in what manner are the total IQ's yielded by these tests associated?

2. How do the SRA primary ability IQ's relate to the Verbal and Performance IQ's yielded by the WISC?

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[1] This article is based on a thesis submitted to the State University of Iowa in partial fulfillment of the degree of Master of Arts. The author gratefully acknowledges the helpful guidance of the late Dr. Beth L. Wellman and dedicates this article to her memory. Gratefulness is expressed also for the help of the other members of the faculty and staff of the Iowa Child Welfare Research Station; and to Dr. Herbert Spitzer, Director of the State University of Iowa University Elementary School, for permission to do research with the children enrolled there.

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METHOD

Fifty children, ranging in age from 8 years, 5 months, to 10 years, 4 months, were given both the WISC and the SRA.[2] These children comprised the 3rd and 4th grades of the University Elementary School, State University of Iowa. They are of superior intelligence, and come from families of high socio-economic status.

The WISC and the SRA were administered to each subject within one month of each other. In order to balance the effects of having one test before the other, half of the children were given the WISC before the SRA, and half of them were given the WISC afterwards. These two groups were equated on the basis of age.

TABLE 1

COEFFICIENTS OF CORRELATION BETWEEN SRA PRIMARY MENTAL ABILITY IQ's AND WISC VERBAL AND PERFORMANCE IQ's

	WISC Verbal IQ	*WISC Performance IQ*
Space	.49	.34
Number	.15	.38
Reasoning	.63	.55
Perception	.18	.42
Verbal-meaning	.68	.40

RESULTS

A correlation of .68 was found between the total IQ's yielded by the two tests. The hypothesis that the relationship between the total IQ's was not linear was rejected at the 5 per cent level of confidence.

The correlations of the primary ability IQ's with the Performance and Verbal IQ's are presented in Table 1. Space, Reasoning, and Verbal-meaning correlate more highly with the Verbal IQ than with the Performance IQ, while Number and Perception correlate more highly with the Performance IQ.

Calculations of the significance of the difference between the two correlations for each primary ability were made, using the formula taken from Johnson (1). The results are given in Table 2. Only the correlations for Verbal-meaning were found to be significantly different, with this difference significant at the 1 per cent level.

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[2] Two examiners administered the tests to the children. Preliminary meetings and training sessions, plus provision for the use of combined judgment in scoring questionable items provided assurance that the techniques of administration and scoring of the tests were essentially the same for the two examiners.

Means and standard deviations for each IQ secured are shown in Table 3. The group mean for the SRA total IQ is 3.3 points lower than the mean for the WISC, and the SRA scores have greater variance. All means, except SRA Number, are above average.

TABLE 2

F SCORE INDICATING THE SIGNIFICANCE OF THE DIFFERENCE FOR EACH PRIMARY ABILITY, BETWEEN ITS CORRELATION WITH THE WISC VERBAL IQ AND PERFORMANCE IQ

IQ	*F Score**
Space	.125
Number	2.708
Reasoning	.515
Perception	2.825
Verbal-meaning	13.260

* An *F* Score value of 4.03 is significant at the 5 per cent level, of 7.18 at the 1 per cent level.

DISCUSSION

A correlation of .68 between the total IQ's on the two tests indicates some degree of correspondence between them. But it does not allow a high degree of predictability from one test to another.

At the beginning of the study certain hypotheses were set up with respect to the relationships of the primary ability IQ's with the Performance and Verbal IQ's. These hypotheses can now be considered along with the relevant results secured.

1. *It is hypothesized that the SRA Verbal-meaning IQ (V) will be more closely related to the WISC Verbal IQ than to the WISC Performance IQ.*

The null form of this hypothesis has been rejected. The correlation between Verbal IQ (WISC) and the Verbal-meaning IQ is .68, and the correlation between Verbal-meaning IQ and the WISC Performance IQ is .40. The difference between these correlations is significant at less than the 1 per cent level.

2. *It is hypothesized that the SRA Perception IQ (P) will be more closely related to the WISC Performance IQ than to the WISC Verbal IQ.*

The direction of the correlation differences is as predicted, but the correlations do not differ significantly.

TABLE 3

MEAN IQ AND STANDARD DEVIATIONS FOR WISC AND SRA ON 50 CHILDREN

	M	*SD*
WISC		
Performance	110.2	12.3
Verbal	113.2	10.8
Total	113.0	10.8
SRA		
Space	117.8	21.2
Number	97.7	10.5
Reasoning	118.0	18.8
Perception	107.9	18.4
Verbal-meaning	116.8	14.6
Total	109.7	13.2

3. *It is hypothesized that the SRA Space IQ (S) will be more closely related to the WISC Performance IQ than to the WISC Verbal IQ.*

The difference between the correlations of .34 and .49, with the Performance IQ and the Verbal IQ respectively, is not in the predicted direction. The difference between the correlations is not significant at the 5 per cent level of confidence.

4. *It is hypothesized that Reasoning ability (R) probably is important for success in both verbal and performance items.*

R correlates substantially with both WISC IQ's. The difference between the correlations of .63 and .55 is not significant at the 5 per cent level.

5. *It is hypothesized that Number (N) will not correlate more highly with WISC V IQ than with WISC P IQ and the correlations with both WISC IQ's will be low ones.*

The difference between these correlations of .38 and .15 (Table 1) is not significant at the 5 per cent level; nor does the second of the two *r*'s reach significance, although the first is significant at slightly less than the 1 per cent level.

Why should Space correlate as highly with the Verbal IQ as it does with the Performance IQ? It is suggested that there may be some processes of verbal conceptualization which are utilized in solving the Space items. Perhaps the child verbalizes to himself concerning the relationships of the geometrical figures, and his success in doing the items may be related to the verbal facility with which he makes these conceptualizations.

Why is the mean for the Number test lower than the other means? Two relevant factors may provide the answer to this question.

1. Content of the Number test. This test consists of addition problems which become progressively more difficult. It has a high speed component.
2. Arithmetic training of the subjects. The arithmetic program of the school places no emphasis on speed. Children are trained in the logic and rationale behind the manipulation of numbers, and are encouraged to check their answers through the use of various devices not used in the original solution of the problem.

Examination of the data indicates that the lower-than-average scores made by these otherwise intellectually superior children were due mainly to the speed factor, and not to inaccuracy of computation. An average of 27.3 addition problems were attempted by each child out of a total of 52 problems, and the average number of errors was only 2.1.

Even if this group of subjects had been given traditional arithmetic training, it is questionable to the writer whether the results of the SRA Number test could be said to give an accurate appraisal of their number abilities. Certainly the ability to handle speedily simple quantitative problems of one type seems to be tested here. However, it is questionable whether the child's ability to do arithmetic reasoning and computation of a variety of numerical problems is tested. These skills are, in the writer's opinion, an integral part of the individual's total numerical ability. The questions raised can, of course, be answered empirically. At this point, however, in the absence of evidence that N is predictive of these other skills, it seems that the limitations of the Number test, in terms of what it does and does not include, should be clearly understood by those using the test to determine a child's numerical ability.

The results of this study are, of course, limited by the fact that a highly selected sample of children was used. In order to increase confidence in them, a larger number of children representing a broader sampling of relevant experimental variables should be tested.

REFERENCES

1. JOHNSON, P. O. *Statistical methods in research.* New York: Prentice Hall, Inc., 1949.
2. THURSTONE, L. L. and THURSTONE, THELMA G. *Examiner manual for the SRA Primary Mental Abilities.* Chicago: Science Research Associates, 1948.
3. WECHSLER, D. *Wechsler Intelligence Scale for Children.* New York: The Psychological Corp., 1949.

STUDIES IN INTOLERANCE OF AMBIGUITY: I. THE DECISION-LOCATION TEST WITH GRADE SCHOOL CHILDREN

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Intolerance of ambiguity has been defined as "the tendency to resort to black-white solutions, to arrive at premature closure as to valuative aspects, often at the neglect of reality. . . ." (4, p. 115). The individual who is intolerant of ambiguity tends to categorize phenomena rather than to order them in a continuum. There is a tendency to precipitate judgment, both in perception and cognition. The theoretical explanation is that this individual feels acutely insecure in ambiguous situations, and hence tends to structure ambiguity prematurely, or at least sooner than individuals more tolerant of ambiguity.

Intolerance of ambiguity has been suggested by Frenkel-Brunswik (4) as the key variable in the ethnocentric personality. Two recent experiments (1, 11) have found that ethnocentrism is positively related to measures of intolerance of ambiguity in college students.

Although the existence of ethnocentrism in children has been well-demonstrated, (see for example 12, 13) there are few studies which bear on its relationship to intolerance of ambiguity at the lower age levels. Frenkel-Brunswik (3) claims to have found it in ethnocentric children in an analysis of interview data. An ongoing study by B. R. McCandless and H. D. Holloway will attempt to relate two measures of ethnocentrism and two of intolerance of ambiguity in elementary school children. No other studies in the area are known to the writer.

The purpose of the pilot work to be reported here is to investigate the usefulness of two proposed measures of intolerance of ambiguity, and to determine their relationship, if any, to ethnocentrism in children at the grade school level.

THE TESTS

Three tests were used in the study, the two proposed measures of intolerance of ambiguity and an ethnocentrism scale. The latter (hereafter referred to as GHME) was devised by Gough, Harris, Martin and Edwards (5). It has twenty-four items which are similar to those commonly used in adult ethnocentrism scales. The child indicates agreement or disagreement with each statement; the ethnocentrism score is the number of agreements. The test-retest reliablity of the GHME is .81.

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One measure of intolerance of ambiguity was the Decision-Location test (the DLT).[2] This is an adaptation of the Incomplete Pictures sub-test of the Minnesota Preschool Scale (14); it consists of two series of twenty straight-line drawings. The first picture of the series is a single line, and more lines are cumulatively added in each subsequent picture of the series, terminating at the twentieth picture as a drawing of a simple object. The final drawings in the two series used here are a truck (DLT_1) and a shoe (DLT_2). No method of estimating reliablity for the DLT has been developed as yet.

The drawings were made into 2 x 2 slides for group presentation. The slides were shown in serial order for 15 seconds each. The subjects were instructed to respond to each slide on a response sheet, which consisted simply of a column of numbers from 1 to 15 with a space for the response next to each number. The response sheet number corresponded to the position of the slide in the series. The crucial aspects of the instructions are presented below:

> Just as soon as you think you know what the picture on the final slide will be, write the name of the object on your response sheet alongside the number corresponding to the slide number. Do this even if you are not quite sure what the object will be. If you have any idea whatsoever of what the completed object will be, write it down in the correct space. However, do not guess if you have no idea at all. In that case, write "Don't know" in the space alongside the number corresponding to the number of the picture. You may change your mind about what the completed picture will be at any time. But do not change anything you have already written.

Etzel (2) found that accurate perception of the final object occurs at about the fifteenth drawing. If the full series of twenty slides were presented, the subjects would become aware of the accurate perception point, and would withhold guesses until that point in the subsequent series. For this reason only the first fifteen drawings in each series were used in this study.

As a further check on any tendency to go back and change earlier responses, the response sheet was broken up in three sections each containing five response spaces. Each was collected in turn before going on to the next five.

The instructions are deliberately made ambiguous so that each subject is free to guess or not to guess according to individual perception. The instructions are, of course, objectively uniform for all subjects, but it is presumed that the child who is intolerant of ambiguity will interpret the equivocal instructions as a requirement to guess as soon, and as much as possible.

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[2] The Decision-Location Test was designed by Drs. Barbara C. Etzel, now at the Bureau of Juvenile Research, Columbus, Ohio, and Sidney Rosenblum, now at the Wayne County Training School, Northville, Michigan. It was originally used in Dr. Etzel's dissertation (2) as an individually administered test. It was revised for group presentation for this study, and for subsequent studies by Drs. Etzel and Rosenblum and the author.

This expectation is founded on the many demonstrations of the effect of need on perception and interpretation.

The score for intolerance of ambiguity is the number of responses other than "Don't know" made prior to the point of clear perception. Clear perception is defined as an unbroken succession of correct responses ranging from some earlier slide to the final slide. It is rare that clear perception occurs before the thirteenth slide, and it is more common to find a correct response only on the fifteenth slide, or not at all.

The second measure of intolerance of ambiguity was the misconceptions test, which consists of forty-two popular misconceptions concerning such subjects as personality, physiognomy, mental illness, hypnosis, and natural science. Twenty items were taken from Nixon's work (10), eight from Hancock (6) and seven from an earlier study by the author (7). The remaining seven are from various sources. Terminology was carefully checked for vocabulary burden in view of the educational level of the subjects. A number of items were revised somewhat in the interests of simplicity.

The subjects were required to choose from three alternatives—true, false, or don't know—for each misconception. The M scale score was the number of misconceptions checked as true. Estimated reliability by the Kuder-Richardson short formula is .70.

Procedure

The ethnocentrism scale (GHME), the misconceptions scale (M), and the first series of the Decision-Location test (DLT), the truck, were administered to a group of sixty-six girls at a community summer camp in Eastern Iowa during the summer of 1953. The ages of the group ranged from 8 to 13 years with a school grade range from the 4th to the 8th. The mean grade level was 5.5, the mean age was 10.23 years.

The mean GHME score for the group was 8.12, the mean M score was 16.25, and the mean DLT was 5.99. The prevalence per misconception was 39 per cent. However, due to the camp schedule, 19 subjects were absent for the administration of the second DLT series, the shoe. The results to be presented here will be based only on the 47 subjects who participated in all phases of the experiment.

Results

The average grade level of the 47 subjects was 5.49, and the average age was 10.11 years, both practically identical with the original group. The means for DLT_1, GHME, and M are also very close to the original means, as can be seen in Table 1. Table 1 also gives the mean DLT score. The DLT score for each subject is obtained by adding her scores for DLT_1 and DLT_2. The DLT score is a more predictive measure than either of the series individually, as will be seen later.

TABLE 1

MEANS, STANDARD DEVIATIONS, AND RANGES FOR THE TESTS

	DLT_1	DLT_2	DLT	$GHME$	M
Mean	5.60	2.79	8.38	8.21	15.96
Standard Deviation	3.32	2.96	5.74	3.89	5.59
Range	0—14	0—15	0—26	2—15	6—28

Despite the precautions which were taken in administration, the scores for DLT_2 are significantly lower than those for DLT_1. The reason for this decline is not immediately apparent. The correlation between DLT_1 and DLT_2 is .66, not as high as might be expected, but certainly suggestive. This correlation may be considered to be a rough index of reliability for the test.

Table 2 shows the intercorrelations between the GHME, M, DLT, and the component series taken individually.

The DLT correlates .39 with the GHME and .43 with the M scale. Both of these correlations are significant below the .01 level. The GHME and M are not significantly related, the correlation being .19. A multiple correlation coefficient predicting the DLT from the GHME and M is .538.

DLT_1 is related to M ($r = .38$) but not to the GHME ($r = .17$). However, DLT_2 correlates significantly with the GHME ($r = .41$), but not with the M scale ($r = .21$). It is possible that the discrepancy between the means of DLT_1 and DLT_2 may be involved in this peculiarity. It is hoped that further investigation will provide a clue.

It is obvious that DLT gives more satisfactory relationships than either of its component series. This is, perhaps, no more than would be normally expected from a pooling of data. Again, we anticipate that additional work with the DLT will be revealing.

TABLE 2

INTERCORRELATIONS BETWEEN THE TESTS

	DLT_1	DLT_2	$GHME$	M
DLT_1	——	.66 *	.17	.38 *
DLT_2		——	.41 *	.21
DLT			.39 *	.43 *
GHME			——	.19
M				——

* Significant below the .01 level of confidence.

DISCUSSION

According to Frenkel-Brunswik's (4) generally accepted formulation to the variable, it was expected that those children who were relatively intolerant of ambiguity would exhibit a premature perceptual closure which would manifest itself in a greater number of precipitate guess responses to the DLT. Insofar as the GHME is a test of ethnocentrism, this expectation is tentatively borne out by the significant relationship between the two measures.

In an earlier article (8) the author advances the hypothesis that intolerance of ambiguity was a causal factor in the belief in superstitions and similar misconceptions. A misconception ordinarily flourishes in the area of ambiguity. The condition in which accurate information is not easily available creates an atmosphere suitable for the dissemination of popular misinformation. A misconception comes under the heading of what Frenkel-Brunswik (4, p. 140) calls "premature reduction of ambiguous cognitive patterns to certainty."

It has been shown (9) that belief in mental hygiene myths is related to ethnocentrism in high school students. The present study indicates that belief in misconceptions in general is associated with perceptual intolerance of ambiguity, but not with ethnocentrism, in elementary school children. It was considered hypothetically that the intolerant-of-ambiguity factor of the ethnocentric child underlies the tendency to accept misbelief. However, the results do not bear out this point.

It is of particular interest that the perceptual measure of intolerance of ambiguity, the DLT, and the cognitive measure, the M scale, which are operationally far apart, are significantly related. Unlike the M scale, the DLT correlates significantly with ethnocentrism as measured in this study. This set of findings appears similar to O'Connor's results (11) in which cognitive intolerance of ambiguity and poor abstractive ability were related to ethnocentrism, but not to each other except in ethnocentric individuals. The relatively poor reliabilities of the tests, and the absence of further information concerning them preclude further analysis of the results at this point.

In general, we believe that the DLT and the M scale show promise as measures of intolerance of ambiguity. A series of experimental studies with the DLT and variations of it is being planned.

SUMMARY

The present study concerned the development of two tests of intolerance of ambiguity, the Decision-Location Test and the Misconceptions scale, and an investigation of their relationship to each other and to ethnocentrism as measured by the Gough-Harris-Martin-Edwards Scale. The subjects were forty-seven girls of ages 8 to 12 with a mean grade level of 5.49.

The DLT was found to be significantly correlated with the M scale and the GHME. The M and GHME were not related. It is concluded that the DLT and M may be regarded as measures of intolerance of ambiguity, and that there are indications that intolerance of ambiguity and ethnocentrism are associated characteristics in elementary school children. Further work along these lines is being planned.

REFERENCES

1. Block, J. and Block, Jeanne. An investigation of the relationship between intolerance of ambiguity and ethnocentrism. *J. Personal.*, 1951, 19, 303-311.
2. Etzel, Barbara C. A study of the effects of frustration upon the preference-for-doing a subsequent task. Doctoral dissertation, State University of Iowa, 1953.
3. Frenkel-Brunswik, Else. A study of prejudice in children. *Hum Rel.*, 1948, 1, 295-306.
4. Frenkel-Brunswik, Else. Intolerance of ambiguity as an emotional and perceptual personality variable. *J. Personal.*, 1949, 18, 108-143.
5. Gough, H. G., Harris, D. B., Martin W. E. and Edwards, Marcia. Children's ethnic attitudes: I. Relationship to certain personality factors. *Child Develpm.*, 1950, 21, 83-91.
6. Hancock, C. H. An evaluation of certain popular science misconceptions. *Sci. Educ.*, 1940, 24, 208-213.
7. Levitt, E. E. The prevalence of modern "superstitions" concerning psychology and psychiatry: a preliminary report. *Amer. Psychologist*, 1952, 7, 245-246 (abstract).
8. Levitt, E. E. Superstitions: twenty-five years ago and today. *Amer. J. Psychol.*, 1952, 65, 443-449.
9. Levitt, E. E. and Clark, C. A. Knowledge of mental hygiene and "probability thinking" in high school students. *Amer. Psychologist*, 1953, 8, 389 (abstract).
10. Nixon, H. K. Popular answers to some psychological questions. *Amer. J. Psychol.*, 1925, 36, 418-423.
11. O'Connor, Patricia. Ethnocentrism, "intolerance of ambiguity" and abstract reasoning ability. *J. abnorm. soc. Psychol.*, 1952, 47, 526-530.
12. Radke, Marian and Sutherland, Jean. Children's concepts and attitudes about minority and majority American groups. *J. educ. Psychol.*, 1949, 40, 449-468.
13. Zeligs, Rose. Children's intergroup attitudes. *J. genet. Psychol.*, 1948, 72, 101-110.
14. *Manual for the Minnesota Preschool Scale.* Philadelphia: Educational Test Bureau, 1940.

SELF-IDENTIFICATION AMONG ADOLESCENT BOYS

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Many psychologists maintain that the child allies himself more closely with the physical aspects of his existence as represented by his body and its function than he does with the mental and emotional aspects because these latter are less accessible and tangible to him (6). Social relationships are carried out with the body, and as a social vehicle it becomes important in the judgments that are made about the total self. From the time of Hall's first writings, adolescent psychology texts have emphasized the upsurge of concern with the body and its adequacy at adolescence. Several investigators have pointed out that the strong, muscular type of physique is a social advantage among adolescent boys. Cabot (2) found "athletosomic" boys more ascendant, extroverted, creative and less socially introverted than those having "leptosomic" or "pyknic" physiques. He concludes that the physique regarded as "good" is a strong determinant in traits which are fundamentally social in their genesis and development. The California Adolescent Growth Studies have indicated that the late maturing boy is likely to suffer some degree of social isolation because of his lag in physical development (4, 5). The immature body of the late-maturing girl does not seem to ostracize her to the same extent.

In these studies the adult investigators make the judgment of whether a physique is "good" or "poor," it being assumed that the adolescent boys' judgment proceeds from the same base-line used by the adult. Those who have been interested in the "body image," or picture of the body which the adolescent is forming in this preoccupation with his corporeal self, believe this image is sharpened by evaluation in terms of what their peers regarded as a "good" physique.

PROBLEM AND METHOD

It might be expected that since the adolescent spends so much time looking at himself in the mirror he should recognize his likeness without difficulty. In response to a challenge by the investigator forty adolescent, ninth grade boys comprising one entire gym class in an urban junior high school agreed to test the contention of several vociferous members of their group that they could easily recognize photographs of their own physiques. Photographs were accordingly taken of the nude subjects, rear view only, under standard lighting conditions from a standard distance. Each subject

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was presented all forty photographs laid out on a table in a predetermined order and asked to identify each photograph, one of which was his own. He was allowed as much time as he pleased to complete the identifications and allowed to manipulate the pictures in any way he wished to make comparisons. The photographs were presented first with the heads covered and then again with the head masks removed to allow total body configuration to be used in the identification. As each photograph was studied the subject rated the physique on a five point scale and stated briefly his reason for the rating. Identification and rating completed he was asked to review the pictures and choose the "best" and "poorest" of the physiques. "Best" and "poorest" were not defined, each subject being asked to use his own subjective criteria for the rating. In addition to this peer group rating, three adult judges rated the photographs according to the Bayley-Bayer scales (1) which take into account the factors of direction, degree, tempo, and amount of incongruity in the same organism in making the sexual differentiation.

A measure of each subject's social standing was obtained through a sociometric technique employing the following questions: 1. With whom would you like best to go to the movies? 2. With whom would you like least to go to the movies? 3. Whom would you like best to have for gym service? 4. Whom would you like least to have for gym service? 5. Whom would you like to have for your best friend? 6. Whom do you like the least in this group?

All of the subjects had been together in the same gym class for at least a year, thirty-five of them for three years, so they had had considerable opportunity to observe each other in a relatively unclothed state. The socioeconomic level of the neighborhood which this school taps is slightly above average but is more heterogeneous than many of the areas in this city. Though all class levels are represented, the skilled working class predominates, with few of the parents falling below that class in occupation. All subjects were native-born, white. Chronological ages ranged from fourteen years, two months to sixteen years, seven months with a mean chronological age of fifteen years (*SD* 6.1 mos.). IQs ranged from a low of 60 to a high of 135, mean 104.6 (*SD* 16.75) by Otis group test.

RESULTS

The three adult judges were able to reach satisfactory agreement in rating the physiques according to the Bayley-Bayer scales. Two of the judges, who had gone over the system and discussed it together before making the ratings, found their judgments in exact agreement in all but three cases and in these three cases the differences were very slight. The third judge, who had had no discussion of the system and had to rely on merely reading the directions before rating, reached 75 per cent agreement with both the other raters, differences again never being greater than placement in an adjacent category.

In spite of the reputed body preoccupation only 12 of the boys (30 per cent), were able to correctly identify themselves when the heads of the photographs were covered. Adding the head to the pool of identification cues raised the number of correct identifications to 15, (or 37.5 per cent). No better than chance relationship existed between the degree of conviction felt in making the identification of any picture and the correctness of the response. They were as often wrong when they felt "certain" as when they "kind of guessed."

No significant difference in mental age appeared between those who correctly identified themselves and those who did not, the mean MA for the successful group being 190.5 months (*SD* 20.2) and the mean MA for the unsuccessful group 190.4 (*SD* 11.3). Chronological age likewise failed to provide a significant factor in success or failure for the mean CA of 180.9 months (*SD* 9.1) of the successful group turned out not to be significantly different from the mean CA of 180.3 (*SD* 6.5) in the group of unsuccessful self-identifiers.

The boys who were able to correctly identify themselves were significantly better in their ability to identify others. This group of successful self-identifiers made a mean number of 31.6 correct identifications (*SD* 3.1) out of the total number of 80 possibilities, as compared with a mean rate of 24.3 (*SD* 1.8) for the group as a whole, a difference which is significant at the 1 per cent level of confidence. This group who correctly identified themselves were also more often correctly identified by others at a mean rate of 31.1 times out of 80 tries (*SD* 5.2), a difference again significant at the 1 per cent level.

Though the group of successful self-identifiers constituted 37.5 per cent of the total group they received only 25 per cent of all social mentions. They did, however, receive 53.7 per cent of the designations as "best" and "poorest" physiques. It would seem possible, then, that the higher rate of identification of themselves and identification by others might be due to physical characteristics which made them conspicuous. This interpretation fails to account for their greater efficiency in identifying others unless one speculates that their physical deviation from the average caused them to be more body conscious both with respect to themselves and with respect to others.

No correlation appeared between the number of times the individual received social mention, either positive or negative, and the number of times he was correctly identified in the group as a whole (Pearson *r* of .00), but the correlation between amount of favorable mention and rate of being correctly identified was significantly positive at the 5 per cent level (Pearson *r* .43±.15). Correlation of degree of social rejection and rate of identification was insignificant but in a negative direction (*r* —.15±.18). There may be a tendency for boys to be more aware of the total person, including the body as part of that total, in the peers they view with favor socially whereas the boys who are socially rejected are so largely on the basis of certain antagonizing personality characteristics. At least, if physical repulsion is any part of the social rejection picture the "image" is not sufficiently impressive to facilitate identification.

In their choice of "best build" the boys appeared to be seeking both masculinity, as measured by the Bayley-Bayer ratings, and symmetry. Two of the four most frequently chosen "best" builds received hyper-masculine Bayley-Bayer ratings; one of these tied for first place while the others trailed at fourth because, as the comments indicated, his shoulders were "too narrow" and "too sloping." The other two "best" builds received masculine ratings on the B-B scale but the one which tied for first place, though merely "masculine," was lauded frequently for its "swell proportions." Comments about preferred physiques overwhelmingly paid tribute to muscle development, with "good muscles," "strong back" and "muscular arms and legs" being most frequently mentioned. The diatribe hurled at the scorned figure was in almost every case "too skinny," with these figures all receiving low masculinity or asexual ratings on the Bayley-Bayer scales. That the boys' concept of what constitutes an ideal masculine physique closely approximates the adult standard is confirmed by the fact that three adult, male judges also chose as "best" the two winning physiques chosen by the adolescent boys.

Though some support is given the contention that the boy with the better physique is socially favored in that the four boys receiving the highest number of favorable social mentions were all rated above average in physique by their peers, the evidence is not as strong as one might anticipate from the generalization to that effect which is frequently made. The four boys suffering the greatest amount of social rejection were all rated average by the group. The general trend of evidence in this investigation gives but feeble support to the "good physique wins social favor" generalization when it is made without regard for the composition of the group in which the social acceptance and rejection is taking place.[1] Jones and Bayley (5) report no consistent or marked differences between early and late maturing boys in prestige and social effects on the group when the group is all boys, but do find prestige differences in favor of the early maturing in mixed groups, especially in later years. In view of their findings, the absence of striking relationship in this group may be due to the homogeneity of the group with respect to sex and the fact that at ninth-grade level the group of boys finds themselves still so transitional with respect to sexual maturity that relative immaturity does not yet make for great conspicuousness, either in appearance or in physical performance.

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[1] A case history, follow-up comment may be made anent the later careers of the subjects showing high physical visibility. Three years after completion of the study the two boys who had tied for "best build" had both dropped out of high school after the tenth grade while the subject voted "poorest build" by a wide margin was graduated valedictorian of his class and showed good social adjustment. The two having "best build" fit neatly into the findings of the Gluecks concerning the predominance of mesomorphic somatype among delinquents (3).

SUMMARY

Forty adolescent boys attempted identification of their own and classmates nude, rear view photographs. Only 37.5 per cent of the subjects were able to correctly identify themselves. Those who were successful in self-identification were also more successful in identifying others and were more frequently identified by others. The study lends but slight support to the generalization that the boy with the admired physique tends to be socially favored. Homogeneity with respect to sex and the age of the group may account for this finding. The most admired physique was that combining strong muscle definition with V-shape symmetry—the stereotype of the strongly "masculine" physique.

REFERENCES

1. BAYLEY, N. and BAYER, L. The assessment of somatic androgyny. *Amer. J. Phys. Anthrop.*, 1946, 4, 433-461.
2. CABOT, P. S. DEQ. The relationship between characteristics of personality and physique in adolescence. *Genet. Psychol. Monog.*, 1938, 20, 3-120.
3. GLUECK, S. and GLUECK, E. *Unraveling Juvenile Delinquency*. Commonwealth Fund, 1950.
4. JONES, H. E. Physical ability as a factor in social adjustment in adolescence. *J. educ. Res.*, 1946, 40, 287-301.
5. JONES, M. C. and BAYLEY, N. Physical maturing among boys as related to behavior. *J. educ. Psychol.*, 1950, 41, 129-148.
6. ZACHRY, C. B. and LIGHTY, M. *Emotion and Conduct in Adolescence*, 1940, D. Appleton-Century, New York.

A DISTINCTION BETWEEN SOCIAL ACCEPTANCE AND PRESTIGE AMONG ADOLESCENTS

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To reveal some of the social pressures which are exerted by an adolescent group on its members, relationships between peer group ratings on certain traits and measures of social acceptance have been found. The results have been interpreted frequently as indicating prestige factors among adolescents (2, 10, 13). But the terms social acceptance and prestige have different meanings. Social acceptance connotes intimate face-to-face contacts which are in some way satisfying. Prestige, on the other hand, indicates the possession of admired or respected characteristics. A trait may be associated with prestige but not with social acceptance. It was the purpose of this study to test the hypothesis that, among adolescents, ratings of social acceptance and ratings of prestige show different degrees of association with other trait ratings.

DEFINITION OF TERMS

Social acceptance has been identified with sociometric status and hence has been measured by the use of a variety of sociometric tests (3, 5, 10). It has also been measured by ratings yielding scores on an acceptance-rejection continuum (3, 14). For this study social acceptance was defined as the extent to which an individual's company is regarded as rewarding by others. It was measured by asking adolescents whom they liked or did not like to be with, whom they enjoyed or did not enjoy having around. This procedure was judged to offer a more general estimate of social acceptance.

Prestige is to be defined in terms of valued characteristics. Benoit-Smullyan (4) has described a person of high prestige as an object of admiration, an object of deference, an object of imitation, a source of suggestion, and a center of attraction. Both he and Hollingshead (7) have indicated that the sources of prestige depend upon the values held by a particular group.

Miller and Dollard (11) have delineated fairly clearly the concept of prestige in terms of imitation. Queener (12) has taken their definition

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of a prestige model as the basis for defining prestige as "the function of being regarded as a source of cues for rewarding responses." Thus an adolescent has prestige if others regard him as one who will cue them as to what to wear to a dance in order that they might receive social approval for being appropriately dressed.

Prestige was defined in this study as the extent to which an individual is regarded by others as possessing valued attributes. Valued attributes are those which constitute cues to responses others perceive as rewarding. To assist in the formulation of statements by which adolescents could rate others, the term "respect" was judged to denote this valuation of attributes by adolescents. Prestige was therefore measured by asking adolescents whom they did or did not respect, whom they thought did or did not have "something worth-while." The results of this rating form, of course, are limited to those aspects of prestige of which adolescents are aware as suggested to them by the terms employed.

Social acceptance and prestige are clearly related among adolescents. The factors which make face-to-face social contacts satisfying include the elements of prestige if for no other reason than the operation of prestige contagion; it is rewarding to be in the company of a prestige person. Furthermore, social contacts themselves result in changes in the value systems underlying prestige. There is also the factor that a person's prestige may be derived from his ability to make social contacts rewarding.

On the other hand some distinction is possible between the two concepts. Being regarded as a source of rewards may increase social acceptance but not necessarily prestige. The boy who shows approval of others or whose actions are entertaining may be sought out because his company is enjoyed but these characteristics will heighten his prestige only to the extent that these attributes are valued. Many factors, prestige sources in the culture, determine this valuational process in addition to the social contacts themselves. This difference is well illustrated by a case reported by Alexander and Alexander (1). Among 27 fourth grade children, they found that Joe received the highest number of choices on three sociometric tests. But a clinical study revealed that "Joe's high number of choices is based on his docility, conformity, and willingness to implement the ideas and projects of others. . . . he provides an outlet for the aggression of others in that it satisfies him and the aggressor" (1, p. 211). This boy's company may have been rewarding to others but he probably had little prestige in the group.

On the other hand an individual who is a source of cues to rewarding responses, who possesses valued attributes, may not supply direct rewards in face-to-face contacts. He may, for example, be so critical of others that few enjoy his company although they hold him in high regard. The distinction made here is implied by Tryon (13) when she spoke of the confusion between friendship-belonging and status-belonging among adolescents. Queener (11) has similarly differentiated between love and respect.

HYPOTHESES OF THE STUDY

Although it was assumed that there would be considerable agreement between social acceptance and prestige as they were measured, it was hypothesized that social acceptance is more closely associated with peer group ratings on friendliness and sociability, number of times chosen as a friend, and number of times chosen as a classroom companion. These traits seemed more likely to be characteristic of those whose company is rewarding. Prestige was judged to be more closely related to ratings on school marks, effort in schoolwork, cooperation with teachers and interest in serious activities, and to the variables of intelligence and socio-economic status. These attributes are more likely to act as cues to rewarding responses than they are to make an individual's company rewarding. Adolescents probably have acquired such value systems from their elders.

PROCEDURE

Guess-who ratings on twelve bi-polar traits were obtained for 443 members of the high tenth grade in a large suburban high school from ninety per cent of this class. Each rater was asked to nominate persons of his or her own sex for 24 statements. In addition, each person was asked to indicate his three best friends and his first three choices for a class-room companion. Although, to encourage unfavorable ratings, raters were asked not to sign their names, a coding system permitted the discarding of all self-mentions. The population for this study consisted of 165 boys and 188 girls who were mentioned on an average of three or more times per trait for each of the twelve traits and thus were fairly well known by the raters.

Ratings for the criterion of social acceptance were obtained from the two following guess-who statements where the first statement was assigned positive values and the second statement negative. Changes on the girls' form are indicated in parentheses. It will be noted that to assist the raters a distinction is made between social acceptance and respect.

> Here is someone whom you like to be with; you may respect him (her) or you may not respect him (her) but you do enjoy having him (her) around.
>
> Here is someone whom you don't like to be with; you may respect him (her) or you may not respect him (her) but you do not enjoy having him (her) around.

In similar fashion the ratings for the criterion of prestige were obtained from the following statements.

> Here is someone whom you respect a lot; you may enjoy having him (her) around or you may not but you do feel that he (she) has something worth-while.

> Here is someone whom you don't respect very much; you may enjoy having him (her) around or you may not but you don't feel that he (she) has very much that is worth-while.

The statements for the other traits of interest for this study were worded in a similar fashion. For purposes of brevity, they may be described by the following paired phrases where the first applies to the statement assigned positive values: gets high marks—gets low marks, tries in schoolwork—does not try in schoolwork, sociable ("a good mixer")—not sociable ("does not mix well"), friendly—unfriendly, cooperates with teachers—does not cooperate with teachers, interested in serious topics—not interested in serious topics. In the last item "serious topics" was defined for the raters as world events, books or ideas, music, art, and scientific subjects.

The ratings were first scored according to CEI methods (6) by simply taking the algebraic sum of the numbers of positive and negative mentions for each trait. The reliabilities of these ratings in terms of amount of agreement among the raters were obtained by dividing the raters at random into two groups. The correlations after correction between the two sets of scores for each trait ranged from .69 to .96 with a median of .85 for the boys and .88 for the girls. These coefficients for social acceptance ratings were .77 for the boys and .76 for the girls while the corresponding figures for prestige ratings were .77 and .87.

The CEI scores for traits which were judged to depend on how widely known by the rating group the individual was were normalized since the distributions tended to be leptokurtic. These normalized scores were used for this study. These traits were social acceptance, prestige, sociability, and friendliness. This change probably did not affect the reliabilities of the two criteria since the correlations between the two normalized traits, .68 and .73, were identical with the correlations obtained between the original sets of CEI scores. Although these correlations are fairly close to the reliability coefficients reported for these traits, the comparison is not entirely appropriate since these reliabilities were based on ratings from different groups of raters while the correlations between the two traits were based on the same group of raters. The criteria of social acceptance and prestige do show, however, a considerable degree of similarity.

The traits which were judged not to be dependent on how widely known the individual was by the rating groups, school marks, school effort, teacher cooperation, and seriousness, were scored according to a method presented elsewhere by the writer (8) in which the CEI scores were weighted inversely according to a measure of how widely known the individual was by the rating group. In support of this procedure, it may be noted that on the traits teacher cooperation and school marks, higher validity coefficients were obtained for the weighted scores than for the CEI scores although the reliabilities were somewhat lower (9). The distributions for these weighted scores were all approximately normal.

The intelligence test scores were obtained with a few exceptions from the Otis Group test. The mean I.Q. for the boys and girls in this population was 104 with a standard deviation of 13. Occupation of father, scored on a scale from 1 to 7 by Warner at al. (15), showed a mean of 3.8 with a standard deviation of 1.4 for the members of this group for whom such data were obtained.

TABLE I

COEFFICIENTS OF CORRELATION BETWEEN RATINGS ON SEVERAL PERSONALITY TRAITS AND TWO CRITERIA (SOCIAL ACCEPTANCE AND PRESTIGE) AND THE DIFFERENCES BETWEEN THEM FOR BOYS AND GIRLS

(based on a population of 165 boys and 188 girls in the high tenth grade)

		Correlation with		
Trait	*Sex*	*Social Acceptance*	*Prestige*	*Difference Between Corresponding z's*
Friendliness	Boys	.60	.61	.02
	Girls	.62	.59	.05
Sociability	Boys	.50	.50	.00
	Girls	.53	.43	.13*
Times chosen as Friend	Boys	.63	.47	.23**
	Girls	.53	.44	.12*
Times chosen as Classroom Companion	Boys	.52	.42	.12
	Girls	.55	.43	.16**
School Marks	Boys	.37	.58	.27**
	Girls	.39	.63	.32**
Effort in Schoolwork	Boys	.41	.55	.18**
	Girls	.46	.69	.35**
Cooperation with Teachers	Boys	.40	.60	.27**
	Girls	.54	.74	.35**
Serious Interests	Boys	.08	.33	.26**
	Girls	.02	.26	.25**
Intelligence†	Boys	.22	.20	.02
	Girls	.14	.22	.08
Occupation of Father‡	Boys	.11	.21	.10
	Girls	.09	.19	.10

† Based on populations of 160 boys and 178 girls.

‡ Based on populations of 134 boys and 162 girls. Warner's scale was reversed so that high scores mean high occupational level.

* Differences significant at .05 level. The values of the standard error of the difference ranged from .05 to .08. These were computed by including the correlational term, $r_{rr'}$, whose values ranged from .54 to .73.

** Differences significant at .01 level. See previous footnote.

RESULTS

The correlations between each of the criteria of social acceptance and prestige with each of the other variables in this study are indicated in Table 1. The significance of the difference between the two correlations was computed for each variable by taking into consideration the fact that these correlations were themselves correlated. For the traits friendliness and sociability the differences were slight and inconsistent although sociability for the girls was more closely related to social acceptance than to prestige at the .05 level. The sociometric type questions produced results which were more closely associated with social acceptance in each case but on only two of the four comparisons were the differences significant at the .01 level with another significant at the .05 level.

All comparisons with respect to school marks, effort in schoolwork, cooperation with teachers and serious interests, showed that these variables were related significantly more closely to prestige than to social acceptance. No large differences were found on comparisons regarding intelligence or father's occupation for this population, all these correlations being fairly low.

DISCUSSION AND CONCLUSIONS

It should be noted first that the criteria, social acceptance and prestige, are closely related. The correlations between them, .68 for the boys and .73 for the girls, are high for trait ratings of this type, and as a consequence the patterns of association with other variables are quite similar. But the fact that significant differences were found indicates that the two concepts, at least as measured by these ratings, are not synonymous.

While social acceptance was more closely related than prestige to all four measures obtained from sociometric type questions, in two of the comparisons the differences were not significant at the .01 level. Since we would expect fairly high agreement, this requires an explanation. The correlations between social acceptance and numbers of times chosen were not high. Ausubel, Schiff, and Gasser (2) with comparable measures found slightly lower coefficients than those here reported. This is attributable to the fact that rejections were not included for these sociometric type questions as they were for the criteria. An individual may be chosen as a friend or companion by many individuals but he may be rejected by even more. If such rejections had been included in the scoring of these questions, the correlations with both of the criteria would have been higher and the differences between them probably would have been larger.

Another factor in these findings is that, particularly for the girls, the measure of prestige probably was more reliable; this would have produced relatively higher correlations for this criterion. A third possible factor is that the more intelligent and more academically successful students may have made more nominations for the guess-who statements and hence were more influential in determining these scores. For the sociometric questions each rater contributed only three nominations, thus providing a more equal weighting for the different groups within the population.

The fact that no large differences were found for friendliness and sociability would suggest that these traits are valued comparatively highly by this population. It should be noted that the raters were asked who was friendly toward or sociable with people in general. Many raters probably nominated persons with whom they had little social contact. Undoubtedly different results would have been obtained if the questions had been worded differently, for example, "Here is someone who is friendly toward you." Raters would have been more likely to nominate those persons whose company was rewarding.

It seems fairly clear that the traits, school marks, effort in schoolwork, cooperation with teachers, and serious interests, are all related to prestige more than to social acceptability. While in the case of the girls particularly the greater reliability of the measure of prestige might have accentuated these differences, the distinction seems quite tenable. The fact that the ratings were obtained in a school situation may have operated to influence the raters' nominations in this direction. But it should be noted that the raters were not asked what attributes they valued; to have done this might more easily have elicited the responses which they felt the school expected of them. The method used in this study for obtaining this information reduced such halo effect and the results probably apply to these adolescents during school-related activities. Somewhat different findings might be obtained if the study were conducted in a city playground or among organizations not connected with the school.

These results cannot be interpreted as representing the value systems of all segments of this population. For example, as Anastasi and Miller (2) have pointed out, differences between those preparing for college and those with no such plans probably exist. It would appear, however, that home, school and community have succeeded in developing certain (middle class?) value systems among a large proportion of these high school pupils.

The fact that the correlations of the criteria with intelligence were low and did not differ significantly would suggest that it is demonstrated ability, for example, in the form of school achievement, which is involved in prestige rather than the kind of potential indicated by intelligence tests. But it is possible that these low relationships resulted from the fact that adolescents with high and low intelligence seldom mentioned each other for either the negative or positive statements of the criteria. An analogous situation may have acted to produce the fairly low correlations obtained for prestige with occupation of father. While the possibility exists that in this urban school a cosmopolitan spirit has been created where little attention is given to the individual's family status, the findings might mean the opposite; adolescents from different class levels may be so far removed that lack of acquaintance prevented their nominating each other for many statements on the guess-who device used in this study.

The distinction between social acceptance and prestige may be an important one. Tryon has pointed out that many adolescents choose companions or friends entirely on the basis of prestige. She suggests that in such situations an individual may be deprived of meeting certain affectional needs which during adolescence must be met in part by his age-mates. In analyzing the nature of the rewards obtained in a friendship, the most desirable situation may be found where one child's prestige for the other is neither excessively strong nor comparatively weak. On the other hand to discover the prestige sources among an adolescent population we may be in error in identifying the individuals with highest social acceptance. It seems probable that for some areas of influence, e.g. behavior at a high school dance, social acceptance may be identified with prestige but for other areas, e.g. behavior in the classroom, a clear distinction may be needed.

SUMMARY

A theoretical distinction was made between social acceptance and prestige by offering different definitions for these terms. The hypothesis that these two traits, as measured by peer group ratings, show different degrees of association with ratings on other traits was tested with tenth grade subjects. While social acceptance was more closely associated with number of times chosen on two sociometric type questions which did not include rejections as did the criteria, two of the four differences were significant at the .01 level and a third at the .05 level. Prestige was significantly more closely associated at the .01 level for each comparison with school marks, trying in school, cooperation with teachers, and serious interests, all of these variables being determined from peer group ratings. Certain implications of the findings were made.

REFERENCES

1. ALEXANDER, THERON and ALEXANDER, MARIE. A study of personality and social status. *Child Develpm.*, 1952, 23, 207-213.
2. ANASTASI, ANNE and MILLER, SHIRLEY. Adolescent prestige factors in relation to scholastic and socio-economic variables. *J. soc. Psychol.*, 1949, 29, 43-50.
3. AUSUBEL, DAVID P., SCHIFF, HERBERT M., and GASSER, EDWARD B. A preliminary study of developmental trends in socioempathy: Accuracy of perception of own and others' sociometric status. *Child Develpm.*, 1952, 23, 111-128.
4. BENOIT-SMULLYAN, E. Status, status types, and status interrelations. *Amer. sociol. Rev.*, 1944, 9, 151-161.

5. Frankel, E. B. and Potashin, R. A survey of sociometric and pre-sociometric literature on friendship and social acceptance among children. *Sociometry,* 1944, 7, 422-431.

6. Hartshorne, Hugh, May, Mark A. and Maller, Julius B. *Studies in the Nature of Character.* New York: Macmillan, 1929.

7. Hollingshead, August B. *Elmtown's Youth: The Impact of Social Classes on Adolescents.* New York: Wiley, 1949.

8. Keislar, Evan R. An improved formula for the scoring of certain guess-who ratings at the adolescent level. *J. educ. Psychol.* In Press.

9. Keislar, Evan R. The validity of the guess-who technique with large adolescent populations. *J. genet. Psychol.* In Press.

10. Kuhlen, Raymond G. and Lee, Beatrice J. Personality characteristics and social acceptability in adolescence. *J. educ. Psychol.,* 1943, 34, 321-340.

11. Miller, Neal E. and Dollard, John. *Social learning and imitation.* New Haven: Yale University Press, 1941.

12. Queener, Llewellyn. The development of internationalist attitudes: II. Attitude cues and prestige. *J. soc. Psychol.,* 1949, 29, 237-252.

13. Tryon, Caroline. The adolescent peer culture. In *Forty-third yearbook* of The National Society for the Study of Education, Part I. Chicago: Dept. of Educ., Univ. of Chicago, 1944. Pp. 217-239.

14. Tryon, Caroline. Evaluation of adolescent personality by adolescents. *Monog. Soc. Res. Child Develpm.,* 1939, 4, No. 4 (Whole No. 23).

15. Warner, W. Lloyd, Meeker, Marchia and Eells, Kenneth. *Social Class in America.* Chicago: Science Research Associates, 1949.

A NOTE ON JUVENILE DELINQUENTS AND THE ABILITY TO ABSTRACT

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In the course of several years experience with male juvenile delinquents, the authors were impressed with the fact that many delinquents knowing that a certain type of behavior was inappropriate or wrong in a given situation did not seem to recognize that this behavior was inappropriate also in another situation which differed somewhat from the given situation. Stated another way, they did not seem able to recognize that situation X, although somewhat different from situation Y, belonged to the same class of situations as Y, P, Q, etc., and that the same rules of behavior applied to each of these somewhat different situations.

The ability to recognize a situation as belonging to a certain class and to regulate behavior accordingly obviously involves a motivational factor, but might it not also involve a basic factor which might be termed "abstract thinking"?

In regard to their findings on the generalizations made by delinquents and non-delinquents, the Gluecks (1) came to this conclusion: "The delinquents apparently do not accumulate a large repertoire of symbols (Vocabulary test) or of symbolized content (Information test). Their generalizations are closely, even though not directly, geared to concrete entities."

Because of this inference regarding the abstracting ability of delinquents, an attempt was made to ascertain whether there was any significant difference between delinquent and non-delinquent males of comparable age and intelligence in the ability to abstract the general principles from proverbs.

SUBJECTS

Thirty-three male high-school students and twenty-nine delinquent boys from Boys Vocational School, Lansing, Michigan served as subjects; they were equated for age and intelligence.

PROCEDURE AND RESULTS

A list of ten proverbs was drawn up and presented in mimeographed form. Both groups were told that this was an attempt to find out something about the way people think. Following this procedure a group intelligence

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test was administered. Next, the proverb sheets were distributed and the subjects were asked to explain, in writing, what each proverb meant.

A rating scale was devised by means of which one of six scores was assigned to each proverb-interpretation for each subject. The scores ranged from zero to three. A subject's score consisted of the total number of points earned. Four psychologists served as independent raters. The correlation coefficients between raters ranged from .88 to .97.

Using one rater as a standard, the ratings of all judges were transformed into comparable scores. When means and standard deviations of the groups had been obtained, the *t*-test was applied to determine the significance of the difference between delinquent and non-delinquent groups. The results indicated that there was no significant difference between the groups in their ability to abstract the general principle from proverbs.

DISCUSSION

The findings in this study do not support the hypothesis of a relative inability on the part of delinquents to engage in abstract thinking as this ability may be measured by the interpretation of proverbs. These findings appear to be in conflict with those of the Gluecks (1).

Further efforts to investigate the importance of this factor of abstracting ability in delinquents should probably utilize a wider variety of techniques before definite conclusions are drawn.

REFERENCES

1. GLUECK, S. and GLUECK, ELEANOR. *Unravelling Juvenile Delinquency.* New York: The Commonwealth Fund, 1950.

MOTOR PERFORMANCE OF CEREBRAL PALSIED CHILDREN AS A FUNCTION OF THEIR SUCCESS OR FAILURE IN ACHIEVING MATERIAL REWARDS[1]

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The successful physical and occupational rehabilitation of cerebral palsied children is dependent primarily upon the efficient learning of motor skills. A mastery of motor fundamentals (i.e., pre-functional activities) and the acquisition of complex, integrated motor patterns (e.g., eating, dressing, washing, etc.) often represent important therapeutic goals.

The development of such motor skills is influenced, to a large extent, by the child's interests and attitudes toward treatment. The importance of motivational variables is reflected, too, in the fact that long and arduous retraining procedures in which the handicapped child participates tend often to produce discouragement and a consequent lack of effort toward attaining treatment goals. Even prior to the inception of therapy, it frequently has been observed that many chronically handicapped children lack the drive and interest which are necessary for learning self-help activities. These observations emphasize the importance of understanding the influence of motivational factors on the motor performance of the cerebral palsied child.

The present study sought to determine the effect of success and failure in securing material rewards on the cerebral palsied child's speed of performance of a pre-functional activity similar to those taught in the hospital's occupational therapy department. It was decided to use material rewards because such incentives had been found by other investigators to be successful in improving the verbal and motor behavior of non-handicapped children.

Certain fairly consistent findings from these previous studies are as follows:

1. The greater effectiveness of reward and reproof in facilitating performance as contrasted with non-incentive conditions (1, 2, 3, 5, 6).
2. The gradual decline in the effectiveness of repetitive, standardized verbal rewards (1).
3. The improvement in performance when a material reward follows a period of either verbal or no reward as opposed to a decrement in per-

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formance when there is a change from a material reward to a non-reward condition (1).

4. The facilitation of performance through the mere presence of material rewards, without regard to the subject's success or failure in achieving them during training (1, 2, 3).

The present experiment was designed as a means not only of demonstrating the effectiveness of material rewards in improving motor performance, but also of testing the commonly-held belief that chronically handicapped children often show less adequate behavior in frustrating situations than they do under non-frustrating circumstances. The experimental conditions of success and induced failure(i.e., frustration) made possible a study of the handicapped child's assumed differential reactions in stressful and non-stressful situations.

EXPERIMENTAL PROCEDURE

Subjects

Twenty-five children who were in residence at the North Carolina Cerebral Palsy Hospital were used in the study. Each subject was assigned to one of five test groups: Neutral ($N = 4$); Success-Reward ($N = 6$); Failure-Reward ($N = 6$); Prolonged Success-Reward ($N = 4$); Prolonged Failure-Reward ($N = 5$).

Initially, the subjects were assigned to these groups on the basis of approximate matching for age, intelligence, physical diagnosis, severity of handicap, cooperativeness (as rated by hospital personnel) and initial test performance. As the experiment progressed, however, the lack of subjects available for experimentation made it impossible to adhere to such rigorous matching procedures. However, an attempt was made to keep all five groups reasonably equivalent with respect to these variables.

The children ranged in age from 6 to 12 years. Both boys ($N=12$) and girls ($N = 13$) were selected, since performance on the motor task which was used did not appear to be a function of sex differences. All subjects were of borderline intelligence or above, except for three children who had IQ's in the sixties. These three children, however, were able to perform the task satisfactorily. Each child's intellectual level was defined by the highest Stanford-Binet (1937 revision—Forms L and M) score obtained during his stay in the hospital, since some children were re-tested one or more times. Since the severity of physical handicap of many of the children influenced their performance on intelligence tests, these obtained IQ's were regarded only as approximations of intellectual levels.

Eighteen of the subjects were spastics and seven were athetoids. All of the children had involvement of at least one of the upper extremities. Some subjects had additional involvements of speech and lower extremities, but, since the experimental task involved the use of only one of the upper extremities, it was believed that this additional handicap would not seriously impair test performance. This was confirmed by observations made in the experimental setting. Although the extent of physical handicap varied, all children met the minimum requirement of having evidenced success in carrying out various self-help activities in the hospital.

Ratings for cooperativeness and adjustment to hospital routine were obtained from therapists' progress notes in the medical folder. Only those children who were reasonably cooperative in participating in the hospital routine were selected for the study.

None of the children tested had had previous experience with the task, although the movements that were involved were somewhat similar to other types of activities taught in the occupational therapy department.

Apparatus

The motor task involved the placing of large wooden cylindrical pegs into a wooden pegboard containing 28 holes. The subject, who was seated at a low table on which the pegboard rested, used his dominant hand to withdraw one peg at a time from a supply in a wooden trough which was placed beside the pegboard.

During the experimental conditions of success and failure, a miniature "community fund" type of scoreboard, which was mounted on an easel, was placed before the subject. This scoreboard contained three identical grooves into which were inserted red masonite strips, each of which could be raised to indicate improvement in the subject's performance. The three grooves were used to represent pictorially the subject's performance on a three-day block of trials. In addition, a miniature Hershey bar, which served as the material reward, was attached to the scoreboard at a specified height above the red marker. Speed of performance was measured with a stop watch.

Procedures

The subject was required to fill all holes of the pegboard for each trial. Four trials daily, spaced one minute apart, were administered for fifteen days with a one-day lapse following both the 6th and 12th day. As can be seen in Table 1, which summarizes the experimental design, five different groups of subjects were used. 1. The Neutral Group (N), which served as a control group, received only verbal praise throughout the fifteen days. 2. The Success-Reward Group (SR) received verbal praise plus the successful attainment of candy rewards. 3. A Failure-Reward Group (FR) was distinguished by verbal reproof accompanied by failure to win the candy reward. These SR and FR subjects were trained under "neutral" conditions for days 1-3, 7-9, and 13-15 and under "success" or "failure" conditions respectively for days 4–6 and 10–12. 4. Prolonged Success-Reward (PSR) and 5. Prolonged Failure-Reward (PFR) Groups were

TABLE I

THE EXPERIMENTAL DESIGN

		CONDITIONS				
Days	*Block*	*Neutral* N	*Success-Reward* SR	*Failure-Reward* FR	*Prolonged Success-Reward* PSR	*Prolonged Failure-Reward* PFR
1– 3	1	Neutral	Neutral	Neutral	Neutral	Neutral
4– 6	2	Neutral	Success-Reward	Failure-Reward	Success-Reward	Failure-Reward
7– 9	3	Neutral	Neutral	Neutral	Success-Reward	Failure-Reward
10–12	4	Neutral	Success-Reward	Failure-Reward	Success-Reward	Failure-Reward
13–15	5	Neutral	Neutral	Neutral	Neutral	Neutral

tested under the same procedures as the SR and FR groups but their "success" and "failure" conditions extended throughout days 4–12. The response measure employed was the time required to fill all 28 holes of the pegboard. Observations of the subjects' behavior during the test trials were recorded by E.

The instructions to the subjects, which were the same for all groups under all conditions, emphasized speed of performance. At the beginning of each trial, the subject was urged to work more rapidly than on previous trials.

Under the Neutral conditions, E's statements at the conclusion of each trial were somewhat similar to the expressions of verbal praise used by the hospital's occupational and physical therapists during treatment. These statements (e.g., "that was fine," "you did well," etc.), although varying slightly from trial to trial, were identical for all subjects.

With the introduction of the "success" and "failure" conditions, the subject was told that the quality of his performance would be recorded on the scoreboard, with increased speed reflected by an upward movement of the red marker. The subject was informed that if he succeeded in making the marker reach the chocolate placed on the scoreboard, he would win the candy.

For the SR and PSR groups, the scoreboard was manipulated to permit the subject to win these candy rewards at the conclusion of each day's trials. In addition, following all trials, standard statements of verbal praise were employed by the experimenter.

Under the FR and PFR conditions, the marker of the scoreboard was moved only minimally in order to prevent the subject from winning the candy. Standard statements of verbal reproof also followed all trials (e.g., "That was pretty slow," "That was so poor that the marker doesn't move at all.").

TABLE 2

GROUP MEANS (RAW TIME SCORES AND CORRESPONDING PERCENTAGE SCORES) AND SIGMAS FOR SUCCESSIVE BLOCKS OF TRIALS

Raw Scores in Seconds — All Groups

	N		SR		FR		PSR		PFR	
Blocks	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*
1	99.40	28.63	118.78	40.55	78.95	18.43	102.80	45.10	68.54	23.58
2	92.65	26.23	96.67	33.20	61.07	13.12	85.00	32.98	56.32	17.36
3	96.00	30.57	101.65	30.68	67.75	17.13	86.55	37.15	58.20	18.84
4	95.15	32.42	94.78	30.73	61.16	13.33	92.13	45.95	58.20	20.20
5	87.25	23.16	101.65	30.68	65.17	14.70	92.38	43.55	63.42	22.74

Percentage Scores — All Groups (Block 1 = 100%)

	N		SR		FR		PSR		PFR	
Blocks	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*
1	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00
2	93.63	4.35	81.78	8.70	77.74	2.20	84.54	5.22	83.59	5.96
3	96.09	6.14	94.47	12.82	85.54	4.69	85.24	7.23	85.91	4.90
4	94.47	6.75	80.38	11.22	78.04	5.58	88.67	8.98	85.30	4.88
5	88.53	3.00	87.75	13.60	82.86	5.93	89.63	8.30	92.55	7.04

RESULTS

The statistical analysis was based upon the mean time of performance for the various groups under the five test conditions. These means were derived as follows: (*a*) Means of the time scores for individual subjects were computed for each successive block of trials (e.g., Block 1 represented the mean time for all 12 trials administered during days 1-3; the Block 2 mean was based on trials for days 4-6, etc.); (*b*) These means were converted into percentage scores represented by the ratio[2] of the mean value for each block divided by the mean value for Block 1, which was assigned a base value of 100 per cent. These conversions were necessary because variations in physical handicap produced marked differences in the response times for trials during Block 1 (the initial neutral condition for all subjects). (*c*) The group means for each block were then computed from the individual subject means which had been derived in (*b*) above.

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[2] It was observed that those children who initially performed the task most slowly also tended to show the greatest improvement in performance as the trials progressed. Hence, it was decided to use ratios rather than difference scores in order to make more equivalent the contributions of the initially slow and initially rapid children to the derived averages.

The two sets of group means (actual time scores and corresponding percentage scores) and their sigmas for successive blocks of trials are presented in Table 2. The mean percentage scores for all groups are plotted graphically in Figure 1. The curves for individual subjects, similarly based upon percentage scores, are presented in Figure 2.

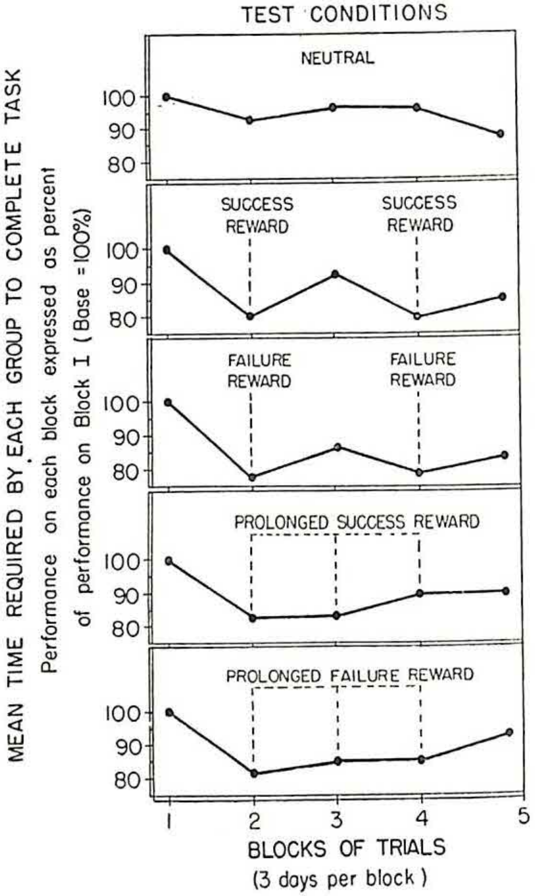

FIGURE 1

Examination of Figure 1 suggests that the shape of the N group curve[3] differs from the shapes of the curves for all four experimental conditions. There is, however, a striking similarity in the shapes of the SR and FR

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[3] Figure 2 suggests that the downward slope of the N curve for Block 5 has been influenced largely by subject S4. The recent addition of three other subjects to the neutral group has resulted in an even more markedly flattened N group curve with little improvement in performance evidenced from Blocks 1-5.

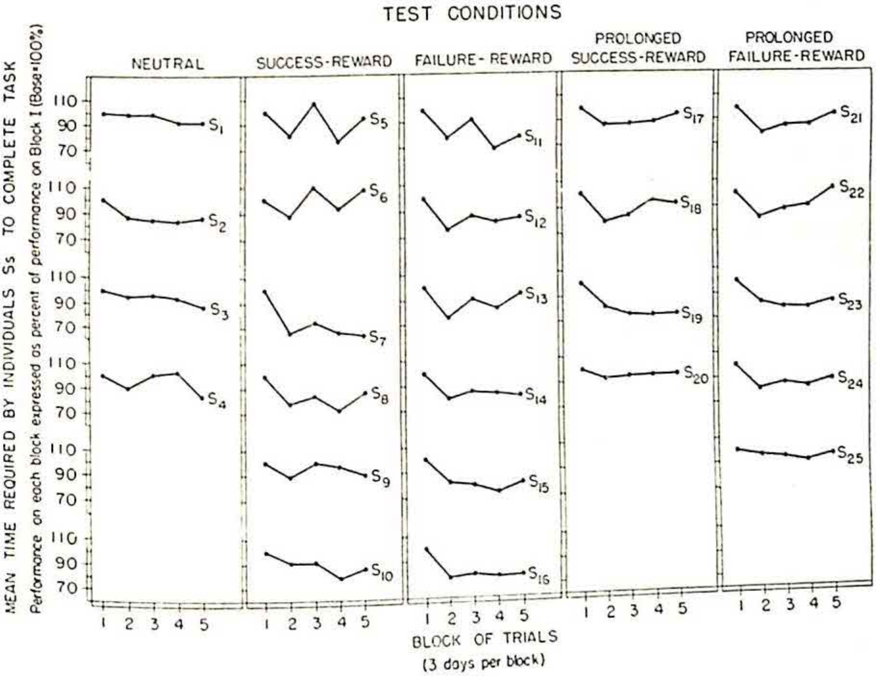

FIGURE 2

curves. The PSR and PFR curves also appear markedly similar. These suggested similarities in performance between the various groups were tested by over-all group, inter-group and intra-group comparisons as described below.

Over-all Group Comparisons

As a preliminary step a simple analysis of variance[4] was used to test whether the means (using converted scores) of all neutral trials for all five groups differed significantly from each other. This analysis yielded an F ratio of 1.12 which, for 4 and 20 *d.f.*, did not permit rejection of the Null hypothesis. Similarly, an analysis of variance of the means for all incentive trials (both success and failure) for the four experimental groups also indicated that there were no significant differences between the groups ($F =$ 1.44; 3 and 17 *d.f.*).

Two conclusions were suggested by these results: (*a*) Any modification in performance which may have occurred under the incentive conditions apparently failed to transfer significantly to subsequent neutral trials. (*b*) The "success" and "failure" conditions used in this experiment apparently were equally effective incentives in modifying motor performance. These conclusions were further tested by inter-group and intra-group comparisons.

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[4] Tests of homogeneity of variance for the group means of the incentive trials as well as the neutral trials did not permit rejection of the Null hypothesis.

Inter-Group Comparisons

Two types of inter-group comparisons were made. Each experimental group was compared with all other experimental groups with regard to the mean performance for all blocks of trials tested under incentive conditions. In addition each of these mean scores for incentive conditions for each experimental group was compared with the mean performance of the Neutral group on parallel blocks of trials. The means and sigmas (percentage values) for these comparable blocks for all groups are presented in Table 2.

TABLE 3

MEANS (PERCENTAGE SCORES) AND SIGMAS FOR COMBINED INCENTIVE AND NON-INCENTIVE BLOCKS OF TRIALS FOR ALL GROUPS

Non-Incentive Blocks

Combined	N		SR		FR		PSR		PFR	
Blocks	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*
1,2,3,4,5	94.55	3.06								
1,3,5	94.87	2.37	94.07	8.62	89.46	2.99				
1,5	94.27	1.50					94.82	4.16	96.28	3.52

Incentive Blocks

Combined	N*		SR		FR		PSR		PFR	
Blocks	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*	*Mean*	*Sigma*
2,4	94.1	4.35	81.1	9.50	77.9	2.91				
2,3,4	94.7	4.94					86.2	6.34	84.9	4.58

* Represents non-incentive blocks of trials of the control group which are temporally equivalent to the incentive blocks of the experimental groups.

The results of *t*-tests (unrelated measures) for significance of differences between these various group means are tabulated in Table 3. They may be summarized as follows: (*a*) The performance of the SR, FR, and PFR groups under material incentive conditions was significantly superior to the performance of the N group (under temporally equivalent trials) tested under verbal praise alone. Although the mean score of the PSR group was superior to that of the N group, this difference merely approached significance. (*b*) With the exception of the superiority of the FR group to the PFR group, there were no significant differences among the experimental groups in their motor performance during trials in which "success" or "failure" in achieving material rewards was operative. (*c*) There was a slight, although non-significant, tendency for superior group performance under "failure" conditions as compared with "success" conditions.

Intra-Group Comparisons

To ascertain whether subjects in each of the experimental groups showed an improvement on incentive trials relative to their performance under the neutral trials, *t*-tests (related measures) for the significance of differences between the means of the incentive and non-incentive blocks were done for all four experimental groups. To test whether similar changes occurred in the Neutral group, *t*-tests were also made comparing the mean performance of the N group on equivalent blocks of trials. The mean and sigma values (in percentage scores) for these comparable blocks of trials for all groups are presented in Table 2.

TABLE 4

TABLE OF INTER-GROUP *t*-TESTS:
SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS (INDEPENDENT MEASURES) OF INCENTIVE AND NON-INCENTIVE BLOCKS OF TRIALS

Groups and Blocks Compared	*t*	*df*	*Level of Significance*
N (2,4) *vs.* SR (2,4)	2.64	8	$<.05$
N (2,4) *vs.* FR (2,4)	5.72	8	$<.01$
N (2,3,4) *vs.* PSR (2,3,4)	1.83	6	NS ($<.20$)
N (2,3,4) *vs.* PFR (2,3,4)	2.68	7	$<.05$
SR (2,4) *vs.* FR (2,4)	.72	10	NS
SR (2,4) *vs.* PSR (2,3,4)	.91	8	NS
SR (2,4) *vs.* PFR (2,3,4)	.79	9	NS
FR (2,4) *vs.* PSR (2,3,4)	2.14	8	NS ($<.10$)
FR (2,4) *vs.* PFR (2,3,4)	2.67	9	$<.05$
PSR (2,3,4) *vs.* PFR (2,3,4)	.30	7	NS

The results of these *t*-tests, which are summarized in Table 4, indicate the following: (*a*) The SR, FR, and PFR groups showed a significant improvement in performance under the incentive conditions as contrasted with the non-incentive conditions. For the PSR group, which also showed improvement, these differences merely approach significance ($p<.1$). (*b*) The N group, however, failed to show any comparable improvement. Thus, both "success" and "failure" in achieving material rewards were effective in markedly improving the motor performance of these cerebral palsied children, whereas the invariant use of verbal praise failed to do so.

The upward trend of the PSR and PFR curves over Blocks 2 to 4 suggested that, as these incentive conditions continued, the material rewards may have gradually lost their reinforcement value. To test this hypothesis, the mean scores for each group on blocks 2 and 4 were compared to see whether performance on the latter trials was significantly slower. The results of *t*-tests (related measures), however, indicated that there were no significant changes in performance over these trials for either the PFR or the PSR groups.

TABLE 5

TABLE OF INTRA-GROUP *t*-TESTS: SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS (RELATED MEASURES) OF INCENTIVE AND NON-INCENTIVE BLOCKS OF TRIALS

Blocks Compared	*t*	*df*	*Level of Significance*
N (1,3,5) *vs.* N (2,4)	.58	3	NS
SR (1,3,5) *vs.* SR (2,4)	5.05	5	$<.01$
FR (1,3,5) *vs.* FR (2,4)	6.96	5	$<.01$
PSR (1,5) *vs.* PSR (2,3,4)	2.48	3	NS ($<.10$)
PFR (1,5) *vs.* PFR (2,3,4)	6.00	4	$<.01$

DISCUSSION

The results clearly indicated that the invariant use of verbal praise, similar to the type usually employed by physical and occupational therapists during treatment, had little effect in modifying the motor behavior of cerebral palsied children. The introduction of material incentives, however, markedly improved their performance of a simple motor task. It was apparent from examination of the curves of all experimental groups that the increments in performance during incentive trials were a function of the mere presence of the material incentives rather than of success or failure in achieving them.

Examination of Table 2 suggests that the FR condition was most effective both in improving performance during the incentive blocks and in transferring such effects to the subsequent neutral trials. Thus, the FR group performed better than all other groups on the final block of neutral trials (block 5). In addition the PFR group performed as effectively as the PSR group on the pegboard task.

On the basis of these results, it becomes difficult to accept any generalized assumption that handicapped children adapt less adequately to frustrating situations than to non-frustrating experiences. The children tested under the FR and PFR conditions were subjected to marked frustration since, in many instances, these subjects were tested concurrently with other children who were being run under "success" conditions.[5]

It became known among the children of the hospital that, while the "failure" subjects were unable to achieve the candy prizes, other ("success") children, who were being tested at a different time during the same day, were successful in gaining these rewards. Nevertheless, the members of the "failure" groups, through their verbal statements to E, continued to manifest a dogged determination to improve in the hope of securing the material incentives. Unlike any of the children in the other groups, these subjects verbally expressed aggression and hostility. Some expressed preference or affection for another psychologist who had not participated in the experiment, while others expressed a dislike of the experimenter or made semi-serious threatening gestures toward him. Such behavior, however, was not excessive nor did it interfere with the subjects' efficiency in performing the motor task.

It was not possible to differentiate the frustration responses of our subjects on the basis of type of cerebral palsy. This finding is of interest in view of Phelps' (7) contention that the reactions to frustration of the athetoid differ significantly from those of the spastic and ataxic. Dr. Phelps has stated that the athetoid tends to be more markedly aggressive following frustration, whereas the spastic child responds in a more stoical fashion. The present findings do not suggest a differential responsiveness to frustration based upon type of cerebral palsy.[6] In view of the small number of subjects used in the experiment, however, it is not possible to draw any extensive generalizations regarding the cerebral palsied child's behavior under frustration.

A consideration of the experimental design is necessary to examine the marked effect of the incentive conditions on the performance of the simple motor task employed in this study. The experiment set out to determine the effect of motivational factors on the motor behavior of cerebral palsied children. It was designed with a view to minimizing insofar as possible, the one most important irrelevant variable, the learning factor, which, in the opinion of some present-day theorists (4), is definable in terms of "habit strength." The literature of recent years on motivation and learning in the realm of animal experimentation has made it clear that performance at a given time is a function of the momentary state of motivation and of the strength of the habit which is under consideration. For a task which is easy to learn, and with motivation held constant, the curve of performance reaches an asymptote after but a few repetitions of the task. The curve of performance for a more difficult task reaches an asymptote more slowly.

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[5] In order to eliminate the introduction of a possible frustrating factor in the test situation, children of the N group were never tested concurrently with children of the incentive groups.

[6] These findings, however, have led to a more specific investigation of Dr. Phelps' contentions. The data, which will be published in a forthcoming paper, failed to support most of his hypotheses.

Examination of the curves for the individual subjects in the N group indicated that an asymptote in the curve of daily performance (not presented) was reached by the 8th to 10th trials (2nd or 3rd days). Since the "habit strength" apparently approached its maximum during the Block 1 trials, it seems clear that the performance on subsequent blocks of trials was being modified by the incentive conditions rather than by learning factors. This heightens the importance of the improvement which followed the introduction of incentive conditions, since far less behavioral variation would have been expected after an asymptote in the performance curve had presumably been reached.

This attempted separation of motivational factors from learning factors, however, restricts the generalizations that can be made about the cerebral palsied child's efficiency of performance under frustrating conditions. It cannot be stated with certainty that the incentive conditions would have similar consequences in the performance of a task that is learned less rapidly and with greater difficulty. We are, therefore, limited in what we can say about the effects of incentives on the learning that occurs in the course of treatment since a large number of the motor tasks which are taught in the departments of physical and occupational therapy involve long periods of learning. This is certainly true of the self-help skills.

In addition, it is possible that a more complex motor habit might be more susceptible to disruption under frustrating conditions than the simple habit of the present experiment, since the complex habit would be less easily overlearned within a short period of time. The use of more complex motor tasks in further experimentation would permit the drawing of broader inferences regarding the advisability of modifying hospital training procedures.

Certain conclusions, however, regarding hospital evaluation and training procedures may be derived from the present study. It is apparent that the constant use of verbal praise produces little modification in motor behavior; material incentives, although initially effective, may decline in reinforcement value if used repeatedly. Occasional variations in the incentive conditions used during training would seem to provide the increments in the level of motivation necessary to facilitate the cerebral palsied child's learning of those complex motor tasks which represent the goals of treatment.

There is an added diagnostic usefulness suggested by the results of the study. The fact that handicapped children often reach behavioral plateaus in learning specific skills poses a diagnostic problem. Are these plateaus caused by lagging motivation, a physiological limit based upon physical disability, or a period of "incubation" in which more complex motor patterns are being integrated? Variations in training procedures, through the use of material incentives during such periods, could help the therapist to determine whether motivational factors are contributing to the failure to make further progress in treatment.

There is a final, broader implication suggested by the study. The results of this investigation are in substantial agreement with the results of other learning studies of a similar nature with non-handicapped subjects. Although there are very few studies of the learning processes of cerebral palsied children, there is available a large storehouse of empirical data on the facilitation of human verbal and motor learning through the manipulation of a wide variety of experimental conditions and techniques. Such procedures offer potential suggestions for modifying the training methods used in the treatment of cerebral palsied patients to induce more efficient and more rapid acquisition of those skills which are necessary for the social and physical growth of these handicapped children.

SUMMARY

The present study sought to evaluate the effect of success and failure in securing material rewards on the cerebral palsied child's speed of performance on a pre-functional type activity. Twenty-five cerebral palsied children were required to place pegs into a series of holes on a wooden pegboard for four trials daily for fifteen days. Five groups of subjects were used: (*a*) Neutral group (N) served as a control group and was motivated throughout by verbal praise alone; (*b*) Success-Reward group (SR) was motivated by verbal praise plus the attainment of candy rewards; (*c*) Failure-Reward group (FR) was distinguished by verbal reproof and loss of candy rewards. The SR and FR groups were trained under "neutral" conditions for days 1-3, 7-9, and 13-15 and under "success" or "failure" conditions respectively for days 4-6 and 10-12. (*d*) Prolonged Success-Reward (PSR) and (*e*) Prolonged Failure-Reward (PFR) groups were tested under prolonged "success" and "failure" conditions (days 4-12). Speed of performance was the response measure employed.

The results were as follows: (*a*) N group subjects showed little modification in performance throughout the practice trials. (*b*) Both SR, FR, PSR, and PFR subjects improved in performance during the "success" and "failure" trials, but these effects did not generalize to subsequent N-trials.

The implications of these results for treatment procedures with cerebral palsied children are discussed.

REFERENCES

1. ABEL, LORRAINE B. The effects of shift in motivation upon the learning of a sensori-motor task. *Arch. Psychol.*, 1936, 29, 5-56.
2. ANDERSON, H. Motivation of young children: Further studies in success and failure, praise and blame. *Child Develpm.*, 1936, 7, 125-144.

3. Chase, Lucille. Motivation of young children. *Univ. Ia. Stud. Child Welf.*, 1932, 5, 5-117.

4. Hull, C. L. *Principles of behavior.* New York: D. Appleton-Century Co., 1943.

5. Hurlock, Elizabeth B. The value of praise and reproof as incentives for children. *Arch. Psychol.*, 1924, 11, 5-78.

6. Hurlock, Elizabeth B. An evaluation of certain incentives used in school work. *J. educ. Psychol.*, 1925, 16, 145-159.

7. Phelps, W. M. Characteristic psychological variations in cerebral palsy. *Nerv. Child,* 1948, 7, 10-13.

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